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ABSTRACT

This module summarizes laws that are relevant to the land application of wastes, focusing on the applicable Federal laws and representative state regulations from different areas of the country. The module describes the 10 points of Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972, that relate to land application. It describes the National Environmental Policy Act of 1969 which requires the submission of formal environmental impact statements for all projects that receive federal funds. It describes the Safe Drinking Water Act which establishes national primary drinking water standards to protect the public health and welfare. It describes the provisions of the Resource Conservation and Recovery Act of 1976 which establishes acceptable practices for the land disposal of sludges. Finally, the module gives a brief overview of the states which have guidelines for land treatment of wastes, focusing on Florida, Texas, Pennsylvania, California and Minnesota--each from a different region of the country, to examine their regulations more closely. The module summarizes water rights laws in the United States as they pertain to land application. (Author/BB)

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Land Application of Wastes

An Educational Program

U.S. DEPARTMENT OF HEALTH,
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LAND APPLICATION
OF WASTES -
AN EDUCATIONAL PROGRAM

The objective of this program is to increase the knowledge of engineers, scientists, waste management specialists and other practitioners in the concepts and principles needed to properly utilize the potential of land for the application of wastes. It is designed for individuals concerned with waste disposal alternatives for municipal, industrial, and agricultural wastes. The modules in this Program incorporate knowledge from sanitary and environmental engineering, agronomy, soil science, agricultural engineering, economics, and law.

The program consists of some twenty-five modules and audio-visual materials as appropriate.

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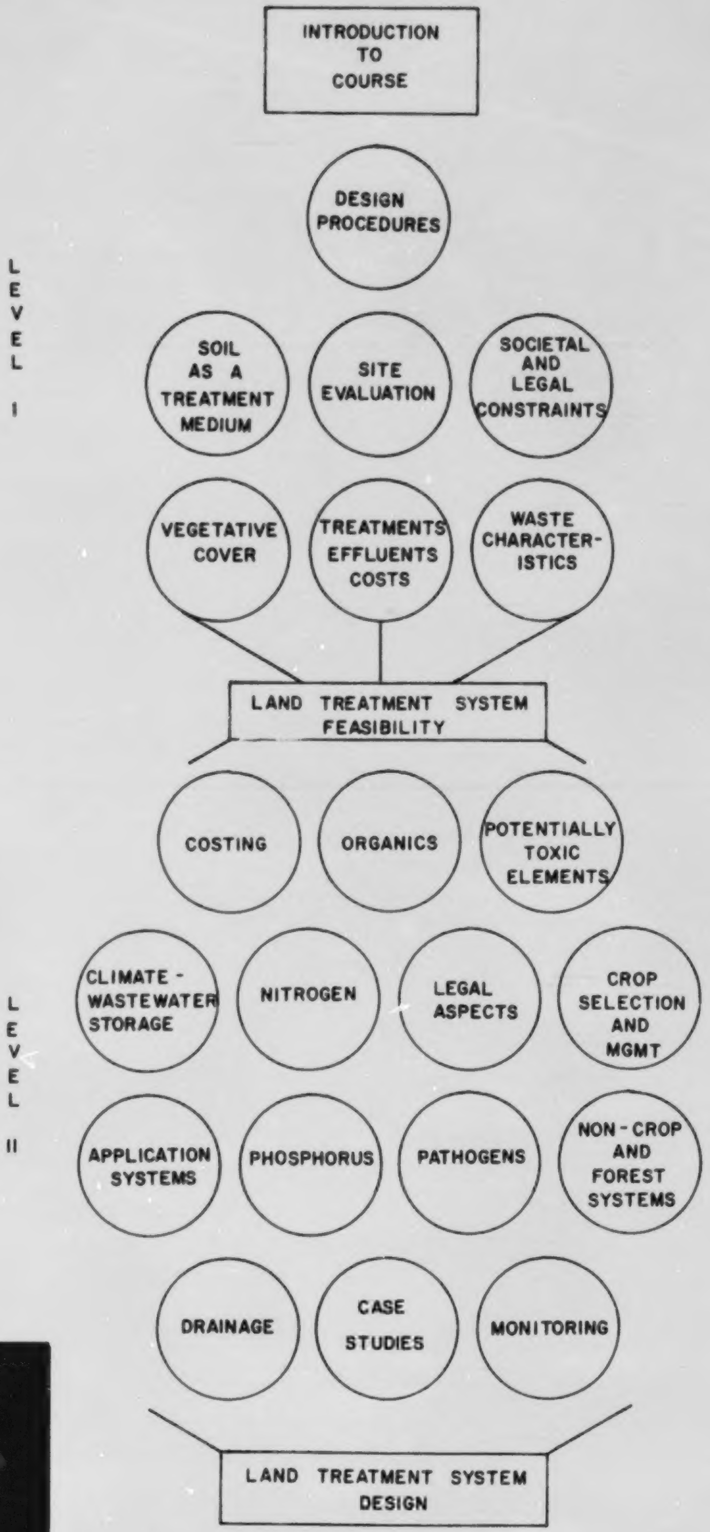

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LEGAL ASPECTS

Module 16

January, 1978

Summary

All waste management systems must meet requirements set by federal, state and local governments. Land treatment systems, just like conventional treatment systems, must meet effluent limitation standards, cost-effectiveness guidelines, and other legal restrictions.

This module summarizes those laws that are relevant to the land application of wastes, focusing on the applicable Federal laws and representative state regulations from different areas of the country. Local governmental structure is discussed in depth in Module 1, "Societal and Legal Constraints". That Level I module emphasizes that local regulation of land application proposals is almost invariably tied to the acceptance which they receive from the community, and points out various techniques which the engineer may use to interact with community groups.

"Legal Aspects" describes the 10 points of Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972, that relate to land application. It describes the National Environmental Policy Act of 1969 which requires the submission of formal environmental impact statements for all projects that receive federal funds.

It describes the Safe Drinking Water Act which establishes national primary drinking water standards to protect the public health and welfare. This federal law empowers the states to set these standards. The land treatment project engineer should know the state's drinking water regulations in order to assess how effluent from the land treatment system will affect the groundwater if it is to be used as a drinking water supply.

It describes the provisions of the Resource Conservation and Recovery Act of 1976 which establishes acceptable practices for the land disposal of sludges.

The module gives a brief overview of the states which have guidelines for land treatment of wastes, focusing on five, each from a different region of the country, to examine their regulations more closely: Florida, Texas, Pennsylvania, California and Minnesota. The module summarizes water rights laws in the United States as they pertain to land application.

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Objectives

Upon completion of this module, the participant should be able to do the following:

1. Describe the legislative basis for the renewed interest in land treatment as a waste management alternative.
2. Discuss several of the points in PL 92-500 and relate them to various aspects of the land treatment alternative.
3. Describe what effect NEPA may have on the installation of a land treatment system and RCRA on a sludge application system.
4. Explain why several states have very similar guidelines for land application of wastes.
5. Discuss several nationwide trends in guidelines for land application of wastes.
6. Discuss several of the legal restrictions which directly affect the engineer in the planning and operation of land treatment systems.

Introduction

The protection of the nation's waterways has long been an interest of the Federal government. The earliest anti-water pollution legislation was passed in 1899. Known as the Rivers and Harbors Act, it included a section which prohibited the discharge of refuse into navigable waters. In 1948 the next important water pollution control legislation was enacted. The Water Pollution Control Act established the policy of giving primary responsibility for pollution abatement to the States, with support and assistance from the Federal government.

The Federal Water Pollution Control Act of 1956 was important to the land treatment area because of three stipulations: 1) the cost of land for sewage treatment was deemed ineligible for grant assistance; 2) no regulations concerning ocean dumping of sludge were provided; and 3) reclaiming and recycling of wastewater were declared ineligible for grant assistance. These stipulations made it very costly to pursue land treatment, since the land area needed is a major cost item. One of the main benefits of this alternative, namely reclamation of water, was not considered when applications for Federal money were reviewed. The lack of regulation of ocean dumping made it convenient for large coastal cities to haul their sludge out to sea. Thus, land treatment was put at a serious disadvantage as a waste treatment alternative (Sullivan, 1973).

The Water Quality Act of 1965 formed the basis of current water quality standards. This Act gave the States the power to implement and enforce water quality criteria for waters of the state (Loehr and Denit, 1975).

The piece of Federal legislation which we will be particularly interested in here is PL 92-500, the Federal Water Pollution Control Act Amendments of 1972. This Act includes several specific goals relevant to waste treatment, including:

- -Zero discharge of pollutants into navigable waterways of the U.S. by 1985
- -Control of point sources of waste discharge from industrial and feedlot operations
- -Maximal use of technology within its economic capability
- -Assessment of alternative management techniques to achieve the aforementioned goals

This module will also review other Federal and state regulations pertaining to the land application of wastes, including water rights legislation which affects water movement, particularly in the western U.S.

Federal Legislation

Four pieces of Federal legislation will be examined in this section: 1) the Federal Water Pollution Control Act Amendments of 1972 (to be referred to as PL 92-500, 2) the National Environmental Policy Act (to be referred to as NEPA), 3) the Safe Drinking Water Act (to be referred to as SDWA) and 4) the Resource Conservation and Recovery Act (to be referred to as RCRA). Primary emphasis will be on PL 92-500.

Federal Water Pollution Control Act Amendments of 1972

This act is a complex program of legislation aimed at cleaning up the waters of the nation. It is long -- nearly 100 pages -- and so complex that sections of it are still being discussed in the courts.

The present discussion will limit itself to those sections and sub-sections which can be directly related to the problem at hand -- land application of wastewaters and sludges.

Ten points have been identified as having direct and significant relevance to land application of wastes. A brief interpretation of the ten sections of the law is presented in the text of the module. The original text of the sections appears in Appendix B.

Ten points of PL 92-500 have special relevance to land application of wastes.

The ten points to be discussed are as follows (in order of appearance in PL 92-500):

Protection of wildlife and recreation resources
Maximization of technology; Best Practicable Waste Treatment Technology (BPWTT)
Recycling of pollutants
Need for cost-effectiveness
Financing of treatment systems
Alternative waste management techniques
Cost of land for treatment systems
Effluent limitations and the zero-discharge goal
Monitoring of treatment systems
Sludge disposal

We are interested in PL 92-500 because it forms the statutory basis for the renewed interest in land treatment of wastes. As noted in the Introduction, water pollution control has been coming under increasing Federal regulation.

PL 92-500 not only points the way for increased activity in the field of land treatment technology, it also places emphasis upon effluent control. Pollution control philosophy has evolved from identifying pollutants which have found their way into the environment, and then trying to eliminate them, to controlling the pollutants at their source -- not allowing them to get into the environment in the first place.

This philosophy, aimed at complete elimination of water pollution in the United States, is in keeping with the national policy of environmental protection established by NEPA.

Water pollution control is expanded by the Safe Drinking Water Act (PL 93-523), which establishes requirements for groundwater quality, among other things.

PL 92-500 represents a basic philosophical shift in controlling the degradation of the nation's waters.

Although PL 92-500 has been called both the best and the worst law ever passed by Congress, there is agreement that it is certainly one of the most complex. The greatest change in pollution control management philosophy is spelled out in Section 301, Effluent Limitations. The section describes allowable levels of pollutant discharge. Before the specific requirements are discussed, brief mention should be made of how this law changed historical pollution management practice. For several decades prior to 1972 the degree of pollutant control required for domestic sewage and industrial wastewaters was related to the potential impact of the discharge on receiving waters. It was assumed that all natural surface waters had a natural purification capacity which could be utilized. The question of how much of this purification capacity could or should be used by any specific pollutant determined the degree of treatment required prior to discharge. Thousands of man-years of research led to the development of knowledge needed to understand the impact of pollutants on receiving waters. Many approaches were based on the presence of oxygen in flowing streams, and the resulting decrease in oxygen concentration caused by the addition of organic wastes. The decreasing oxygen concentration below a waste outfall, and the eventual return to a high dissolved oxygen concentration farther downstream was called the "oxygen sag". Nationwide planning was instigated to classify waters in terms of the amount of waste discharge that would be acceptable at all points, both in large river systems and small streams. This classification system was based on the potential use of each surface water resource. For example, if the water body was a drinking water source, only a small fraction of its purifying capacity could be utilized. On the other hand, some waterways could receive large amounts of pollutant discharge if their use was deemed to be minimal. This was the general situation that existed in water resource planning and engineering prior to the passage of PL 92-500.

Previous water pollution legislation focused on stream classification, and allowable pollutant discharge based on these standards.

One obvious problem with the historical approach to pollution control planning is that "Mother Nature" may not agree with the arbitrary classification system. Natural flow variations in water bodies and potential of treatment system failure could cause wide fluctuations in the fraction of the purification capacity utilized. This could lead to fish kills and other highly visible evidence of incomplete pollution control. Public concern mounted when individuals began to fear that certain water quality classifications would not provide desired control. Further disenchantment with this general approach developed as the potential danger from environmental pollutants became manifest. The most common example was the increasing problems of aquatic weed and algal growth caused by pollutants which had no direct effect on the oxygen budget of flowing water, that is, nitrogen and phosphorus. It is extremely difficult to predict the stream assimilation capacity of the plant nutrients in order to avoid nuisance vegetative growth. Finally, the public became aware that widespread distribution of pollutants could not only cause undesired plant growth, but that toxic elements could be concentrated by normal biological activity. The mercury problem illuminated the fact that certain pollutants, discharged at presumably safe levels, could ultimately cause significant damage. Many people became intimately involved with wastewater pollution effects when swordfish was banned due to high mercury concentrations in the flesh of the fish. The ban on phosphorus in household detergents in some areas further emphasized the problem.

Several problems with the pre-1972 pollution control approach led to the development of the effluent limitations of PL 92-500.

Eutrophication of surface waters and mercury contamination of marine fishes brought the pollution problem to the public's attention.

The general intent of PL 92-500 to eliminate discharges of pollutants was a reflection of a widely held notion generated by this situation and many other interacting factors. The 1972 amendments indicate that all polluters must take responsibility for their wastes. The receiving waters should not be degraded. Although some have interpreted the law to mean complete elimination of discharge of all matter, a careful reading of the law shows that this is incorrect. In general, the degree of pollutant control required is related to a level proven in full-scale application to be 1) capable of the necessary control and 2) economically acceptable. An alternative which would achieve the greatest control over pollutants and would appear to offer the possibility of eliminating the discharge of many pollutants is land application of waste. This technology not only responds to the letter of the laws, but also to the current widely-held opinion that maximum control over pollutants be required.

Finally, any pollution control agency's difficulty in controlling discharges when relating them to the vagaries of a receiving water body made a nearly impossible task out of pollutant regulation. By clearly relating the acceptable discharge levels to technically - and economically - available methods of pollution control, a clear basis of regulation could be developed. The following sections discuss the increasingly strict levels of pollutant control that will be required in two major steps in the near future.

PL 92-500 has been under intensive review since its passage in 1972. One of the provisions which has received a great deal of study is Section 301, dealing with the effluent limitations schedule intended to remove as many pollutants as possible from navigable waterways.

Several recommended changes to PL 92-500 were submitted by the National Commission on Water Quality, chaired by Vice President Rockefeller, on March 2, 1976. This commission has been charged with a review of PL 92-500 to determine what changes should be considered by Congress. In general, the recommendations supported all major components of PL 92-500. The text of the Commission's recommendations appears in Appendix A.

PL 92-500, passed in 1972, is still undergoing intensive review and change.

Following are interpretations of several sections and subsections of PL 92-500 which are particularly applicable to the land application of wastes. The text of the law appears in Appendix B.

Section 102(a); 201 (f): Protection of wildlife and recreation resources

In developing water pollution control programs, consideration must be given to the protection and propagation of fish, aquatic life and other wildlife, and to recreational resources and open space preservation.

Land treatment systems, by their very nature, require large amounts of open land, and thereby automatically enhance a given area by keeping this acreage as open, undeveloped space. Additionally, these systems can be designed and managed to provide planned open space, as well as areas for recreation and wildlife habitat. Several alternate management schemes are described in Module 13,"Non-Crop and Forest Systems".

Section 201 (b): Best practicable waste treatment technology

This is one of the more important sections of the law. It deals with the requirement for best practicable waste treatment technology (BPWTT). BPWTT must be used on all discharges to receiving waters. Thus, water which is renovated through land treatment may be considered to have undergone BPWTT.

"Best Practicable Treatment" has been interpreted as technology that has been demonstrated to be successful in a significant number of full-scale operations. Thus, a strict interpretation would suggest that land treatment could only be used in cases where it has already been shown to be an effective technology. On the other hand, land treatment is often cited as a viable treatment alternative. Recommendations for cost-effectiveness, preservation of open space, and enhancement of recreation and wildlife resources all are satisfied by the land treatment alternative.

The waste management alternative chosen for a particular site must be shown to be the best practicable treatment technology, in order for the project to be eligible for Federal funds.

Section 201 (d) (1); 201 (g) (2) (B): Recycling of pollutants

Treatment works proposed for grant assistance are, whenever possible, to take into account the possibility of recycling or reclaiming the water, or otherwise eliminating the discharge of pollutants.

Waste management alternatives should seek to recycle the resources in the wastes being treated.

The use of wastewater for irrigation at the land treatment site is one method of recycling pollutants. Not only are the pollutants recycled to produce a benefit (the crop), but the crop may in turn be sold to help pay the cost of operating the system. Module 5, "Waste Characteristics", discusses the constituents of wastes.

Section 201 (e): Cost-Effectiveness

Waste treatment plants shall be designed and operated in such a manner as to produce revenue. Harvesting a crop from a land treatment site is perhaps the most common method of generating revenue. The site may also be managed as a recreational area, with user fees collected to pay for the system and other area improvements. Managing a crop on a land treatment site is discussed in Module 20, "Crop Selection and Management Alternatives".

Waste management alternatives which are cost-effective are most desirable and should be utilized.

The need for cost-effectiveness is noted in several other sections of the law. Clearly, this is an area where a large amount of information remains to be developed by researchers and pollution control system managers. Costing land treatment systems is discussed in Module 10, and comparison with conventional alternatives in Module 4, "Treatment Systems, Effluent Qualities and Costs".

Section 201 (g) (1): Financing

Publicly owned treatment works, including land treatment systems, are eligible for grant assistance from the Federal government. Section 202 (a) stipulates that the Federal government will authorize grants of 75% of the construction costs of projects that meet all the requirements of PL 92-500. In some areas, a significant portion of the remaining non-federal portion is paid by the State, and only a small portion is paid by the community.

The Federal government may offer grant assistance to projects meeting the requirements of PL 92-500.

Although space does not allow a detailed consideration of financing, two details are worth noting. First, the new law clearly specifies that industry should pay for its share of the cost of the waste management system. Thus, industry would also be interested in identifying the most cost-effective alternatives. The second point to note is that in light of the financing obtainable through federal sources the most significant financial burden for the community is the continuing cost for operation and maintenance of the systems. Any system which produces a salable by-product can reduce this continuing cost.

Section 201 (g) (2) (A); 304 (d) (2): Alternative techniques

EPA is authorized to make grants to any state, municipal, or cooperative governmental agency for the construction of publicly-owned waste treatment facilities. This applies to the construction of land treatment sites as well as conventional plants.

All possible alternatives for waste management must be explored in order for a project to be eligible for grant assistance.

However, grants cannot be authorized unless the municipality or agency involved has shown EPA that all waste management alternatives have been explored. The grant must be requested for that management alternative which is deemed to be the Best Practicable Waste Treatment Technology. Land treatment must, therefore, be evaluated as one of the existing treatment technologies. THIS PART OF THE LAW IS ONE OF THE PRINCIPAL DIRECTIVES FROM THE FEDERAL GOVERNMENT TO EXPLORE THE USE OF THE LAND TREATMENT ALTERNATIVE. Subsequent directives from EPA have reiterated the importance of evaluating land treatment as a viable alternative.

Section 212: Definitions

This section stipulates that acquisition of land that will be an integral part of the treatment process, or is used for ultimate disposal of treatment residues, will be eligible for grant assistance. This reverses the situation created by the Federal Water Pollution Control Act of 1956, which did not allow Federal grant assistance for land acquisition for treatment plants in any case. However, the land on which a conventional treatment plant is located is not eligible for grant assistance. This gives a financial boost to the land treatment alternative, as land costs are often the largest cost item for these systems.

Cities or towns buying land which is an integral part of the waste treatment system are eligible for Federal grants to assist them in paying for the land.

Section 301: Effluent limitations

This section describes the timetable to be used to reach the goal of zero discharge of pollutants to waters of the nation by 1985.

By July 1, 1977: Effluent limitations for point sources other than publicly-owned treatment works, or publicly-owned treatment works in existence on that date, shall meet the standards for secondary treatment as defined by EPA. The best practicable control technology currently available, as defined by EPA, shall be utilized in reaching this goal.

A schedule is established to work toward the goal of zero discharge of pollutants by 1985.

By July 1, 1983: Effluent limitations for point sources shall use the best available technology economically achievable to make reasonable progress toward the national goal of elimination of all pollution discharges by 1985.

All publicly-owned treatment works shall have adopted the best practicable waste treatment alternative as defined by EPA.

Section 308: Monitoring

This section of the law describes monitoring requirements for point sources of pollution.

Monitoring is required to carry out the objective of the law (attainment of zero discharge) and will be used in developing effluent limitations and standards. The owner of any point source of pollution shall establish and maintain records, make reports, install monitoring equipment, sample effluents, and provide any other required information, as specified by EPA.

Specific monitoring requirements for point sources of pollution are prescribed by the EPA.

The section also describes the rights of access to monitoring information by EPA.

While PL 92-500 requires monitoring only for point sources of pollution, most states require a monitoring program for land treatment systems. State requirements for monitoring are described in Part III of this module. Module 18, "Monitoring", describes monitoring techniques for land treatment systems.

Section 405; 201 (d) (4): Disposal of sewage sludge

Conventional treatment processes yield both sludges and liquid effluents. This section deals specifically with the sludge component of sewage wastes, and stipulates that sludge must be disposed of in such a way that no pollutants from the sludge will enter a navigable waterway, unless a permit for such discharge has been obtained from EPA. The question of ocean dumping of sludge must now be addressed in light of this section.

The disposal of sewage sludge in a manner which will lead to the discharge of pollutants to navigable waterways is prohibited. This is especially pertinent to the question of ocean dumping of sludge.

The section is also relevant to land application of sludges, since such application may result in runoff of pollutants to surface waters if the sludge is not handled properly. A common method of controlling runoff from sludge application to land is to inject or otherwise incorporate the sludge into the surface layer of the soil. Application systems are addressed in Module 12, "Waste Application Systems".

Discussion

The position of the Environmental Protection

Agency toward the land treatment alternative is clearly stated in a memorandum from Deputy Administrator John Quarles, dated November 1, 1974.

In the memo, Mr. Quarles expresses concern that EPA must do a better job to ensure that land treatment is given an adequate chance as a viable treatment alternative in accordance with the mandate of PL 92-500.

In addition, Mr. Quarles suggests that Regional Administrators attempt to heighten public awareness of the land treatment alternative within their region. The complete text of Mr. Quarles' memorandum is reproduced in Appendix C. The EPA position is updated, and stated in even more forceful terms, in an October 3, 1977 memorandum issued by Administrator Douglas Costle (Appendix J).

The Environmental Protection Agency is taking steps to ensure that the use of land treatment as an alternative waste management technique is considered.

These memoranda are clear indications of the concern of EPA regarding the consideration of land treatment as one of several viable waste treatment technologies available. Where it is cost-effective and otherwise meets the requirements of PL 92-500, it must be considered as an alternative. Where a waste treatment method encouraging water conservation is not recommended, permit applicants must justify rejecting land treatment. Also, the EPA will withold funds from pretreatment facilities required by the states for approval of land application systems, if this pretreatment is deemed unnecessary by EPA.

In the years following the passage of PL 92-500, the requirements which the law stipulates are being developed and published. Criteria for determining the Best Practicable Waste Treatment Technology using land application and land utilization techniques have been set, and include the following:

EPA requires consideration of land application in any wastewater treatment feasibility plan. Permit applicants must justify rejection of land application, and states must justify preapplication treatment standards to receive federal funding.

1. Treatment which results in discharge to a navigable waterway shall meet the requirements for secondary treatment. The engineer should contact his state agency or the regional office of the EPA for the up-to-date definition of secondary treatment.

2. The groundwater resulting from the land treatment site, including the native groundwater, shall be applicable to one of the following three cases:

   Case 1: The groundwater can potentially be used as a drinking water supply.

   Case 2: The groundwater is used as a drinking water supply.

   Case 3: The groundwater is used for purposes other than a drinking water supply.

In each case, groundwater quality criteria are established which must be met by new discharges to the groundwater. These criteria are reproduced in total in Appendix D.

The National Environmental Policy Act of 1969 (NEPA)

The National Environmental Policy Act of 1969 is the cornerstone of Federal environmental legislation. Unlike the Water Pollution Control Act Amendments just discussed, NEPA regulates all federally-funded projects which have a significant environmental impact. It addresses the need to protect and enhance the quality of the environment for this and future generations. The most important aspect of this law is the requirement to submit formal environmental impact statements for all projects involving federal funding.

The National Environmental Policy Act reflects the interest of Congress and the Nation in preserving and enhancing the environment.

Four major goals are defined for this Act:

- To declare a national policy to encourage a productive and enjoyable harmony between man and his environment
- To promote efforts to reduce damage to the environment
- To enrich the understanding of the environment
- To create the Council on Environmental Quality

Below is presented a general interpretation of how NEPA relates to the land treatment alternative. The text of the Introduction and Title I of NEPA appears in Appendix E.

All practicable means and measures shall be used to promote the general welfare, to create and maintain conditions under which man and nature shall exist in harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans. As treatment of our wastes is rapidly becoming a crucial factor in the protection of our environment, this phase of our lifestyle -- waste management -- is germane to NEPA. Land treatment of wastes is the management alternative which is most closely tied to natural systems. It is crucial, therefore, that the natural systems which allow wastes to be assimilated by the soil continue to function. The philosophy of NEPA is therefore closely tied to the continued success of land treatment systems.

It is the responsibility of the Federal government to use all practicable means to improve Federal programs and resources to fulfill the objectives of NEPA. One of the stated objectives is to enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources. Water is a resource which can be recycled and reused. Land treatment is one means of accomplishing this recycling, while also recycling nutrients such as nitrogen, phosphorus, and trace elements through the soil-vegetation system.

As land treatment systems will have a definite effect on the surrounding environment, as well as on the waters leaving the treatment site, it can be seen that NEPA may well have a bearing on the development of these systems.

NEPA has been the major piece of legislation used by environmentalists in their efforts to legally question projects which they feel will damage the environment. Therefore, it is well for the design group to keep in mind the requirements of NEPA when it is designing a land treatment system.

Land application systems may fall under the jurisdiction of NEPA insofar as the requirement for impact statements is concerned.

NEPA is the law which mandates an Environmental Impact Statement for certain projects. The requirement for an impact statement is one which, if not dealt with at the outset of a project, may cause considerable delay and expense in completing the project. It is important for the design group to know when an impact statement is required, and how to go about preparing one which will satisfy the demands of the law (and, if need be, the courts).

All Federal agencies are to use a systematic, interdisciplinary approach to ensure integrated use of the natural and social sciences and the environmental design arts in decision-making which will have an impact on the environment. Land treatment system design will require the expertise of soil scientists, engineers, and social scientists to ensure that these systems will have no adverse effect on the community in which they are installed. This is particularly important for large systems which cover several thousand acres, and which may dislocate families, or even entire communities.

Where alternate uses of natural resources are in question, alternate courses of action shall be studied, according to NEPA. Thus, land treatment may be considered a better alternative to tertiary treatment in light of NEPA, as land treatment would allow for direct reuse of the water and nutrients by irrigation. Of course, the decision as to alternate courses of action must be made in terms of the requirements of PL 92-500, as well as those of NEPA. While the recycling and reuse of resources is stressed in PL 92-500, we have also seen that cost-effectiveness, preservation of open space, recreation and wildlife areas, and maximization of technology (BPWTT) must be considered before a final decision is made as to which waste treatment technology will be utilized.

The Safe Drinking Water Act (SDWA) - PL 93-523

The Safe Drinking Water Act is a legislative attempt to provide enough good drinking water for everyone. The Act calls for EPA to establish national primary drinking water standards to protect the public health and welfare. Water which meets these standards will be safe to drink, without having any unpleasant odor or appearance.

SDWA pertains to the land application of wastes insofar as it calls for the protection of underground sources of water which are used for drinking water supplies.

Primary responsibility for water standards implementation and enforcement is given to the states. Once a state has shown that it meets the requirements for primary enforcement responsibility, it is expected to adopt standards, review compliance strategems, and enforce its standards.

Land treatment design engineers must be cognizant of the state's drinking water regulations in order to assess how the effluent from the land treatment system will affect the groundwater, if the groundwater is used as a public drinking water supply.

The Safe Drinking Water Act requires protection of the groundwater as a future source of drinking water.

In accordance with the provisions of SDWA, EPA promulgated National Interim Primary Drinking Water Regulations in December of 1975. These regulations, along with additional ones dealing with radioactivity in drinking water, became effective in June, 1977. The states may propose their own set of standards; however, state standards must be at least as stringent as those proposed by EPA. Since this is the case, individual states must be contacted as to the specific guidelines in force. In addition, different states may use different definitions in deciding whether groundwater is a public drinking water supply. In some cases, all groundwater may be considered to be public drinking water supply, and all effluents which percolate to the groundwater from land treatment systems in those states would be required to meet the groundwater standards established by the state or by EPA in the absence of state criteria.

Again, it is emphasized that in evaluating land application as a Best Practicable Waste Treatment Technology in accordance with PL 92-500 the groundwater quality criteria established by the Interim Primary Drinking Water Standards (mandated by SDWA) must be followed.

The Resource Conservation and Recovery Act (RCRA)

Environmental controls are playing an increasingly important role in sludge management. The RCRA of 1976 (PL 94-580) provides for the establishment of three programs:

- a hazardous waste program that provides a "cradle to grave" system for managing hazardous wastes
- a land disposal program that establishes "acceptable" practices for the land disposal of non-hazardous wastes
- a resource conservation and recovery program

RCRA regulates sludge land application and sludge disposal in landfills.

RCRA pertains directly to wastewater treatment plant sludge, as it is included in the act's definition of "solid waste", along with garbage, refuse, water treatment plant sludge, and air pollution control sludge. The law encompasses both sludge land application and sludge disposal in landfills. Most relevant to land application is the establishment of acceptable practices for the land disposal of non-hazardous wastes. EPA is to develop criteria to determine which disposal facilities are acceptable and which are unacceptable. These criteria are extremely important because any unacceptable solid waste practice is prohibited by the RCRA unless it is covered by a schedule of compliance that has been approved by the EPA.

RCRA calls for the EPA to develop criteria to determine which disposal facilities are acceptable and which are unacceptable.

Implementation of these criteria would rest solely with each individual state. The state agency may issue permits to control implementation of the EPA criteria, and require that records be kept at the treatment plant to insure that the criteria are met.

It is up to the individual states to implement the EPA criteria for acceptable disposal facilities.

EPA is also required to publish guidelines for the development of state plans and the provision of financial assistance to state programs. To be approved for financial assistance, the RCRA requires that state plans must: 1) prohibit the establishment of unacceptable facilities, 2) provide for the closing or upgrading of existing unacceptable facilities, and 3) provide a schedule for compliance with the criteria within a reasonable time, not to exceed five years from the publication of an inventory of unacceptable disposal facilities that EPA will publish one year after the promulgation of the criteria.

EPA is also required to publish solid waste management guidelines. These will include guidelines which describe disposal practices that can be used to meet the disposal facility criteria. These guidelines are not mandatory for the states; they are advisory only. They are mandatory for all Federal facilities and certain grantees under the RCRA.

It is now envisioned that the EPA criteria will both establish "environmental limits" where possible, and require the use of best practicable technology where appropriate.

Descriptive operating methods will be covered in the guidelines describing ways of protecting health and the environment, or best management practices, and they will be waste specific. Initially, the EPA is expected to write guidelines on municipal solid waste land disposal, and municipal sludge land disposal.

The RCRA assures enforcement of the hazardous waste program at state and Federal levels. However, there is no Federal enforcement for the land disposal program.

Sludges which are hazardous will be covered under the hazardous wastes control program. In determining a hazardous waste, RCRA states that one should take into account "toxicity, persistence, and degradability in nature, potential for accumulation in tissue. . . " Although most wastewater sludges contain some amount of such substances as cadmium, mercury, and PCB, it is expected that only a small percentage of municipal sludges would fall under the hazardous wastes provisions of the RCRA (Claussen, 1977).

Sludges which are deemed "hazardous" will be regulated by the separate hazardous waste control program under the RCRA. Only a small percentage of municipal sludges will fall under the "hazardous" category.

State Regulations and Guidelines

Introduction

Congress, in passing PL 92-500, gave the nation a clear mandate to reassess conventional waste management alternatives. Emphasis was placed on alternatives which are cost-effective, utilize the best practicable treatment technology, and consider reuse and recycling of water and nutrient resources which are the major components of sewage wastes.

The states are, of course, cognizant of the increasing interest in the land application alternative. Many have developed regulations and guidelines for this method of waste management for use within their boundaries.

Several studies have attempted to summarize the position of each of the states with respect to land application. Such a study was prepared by Temple University in 1972 (Stevens, et al, 1972).

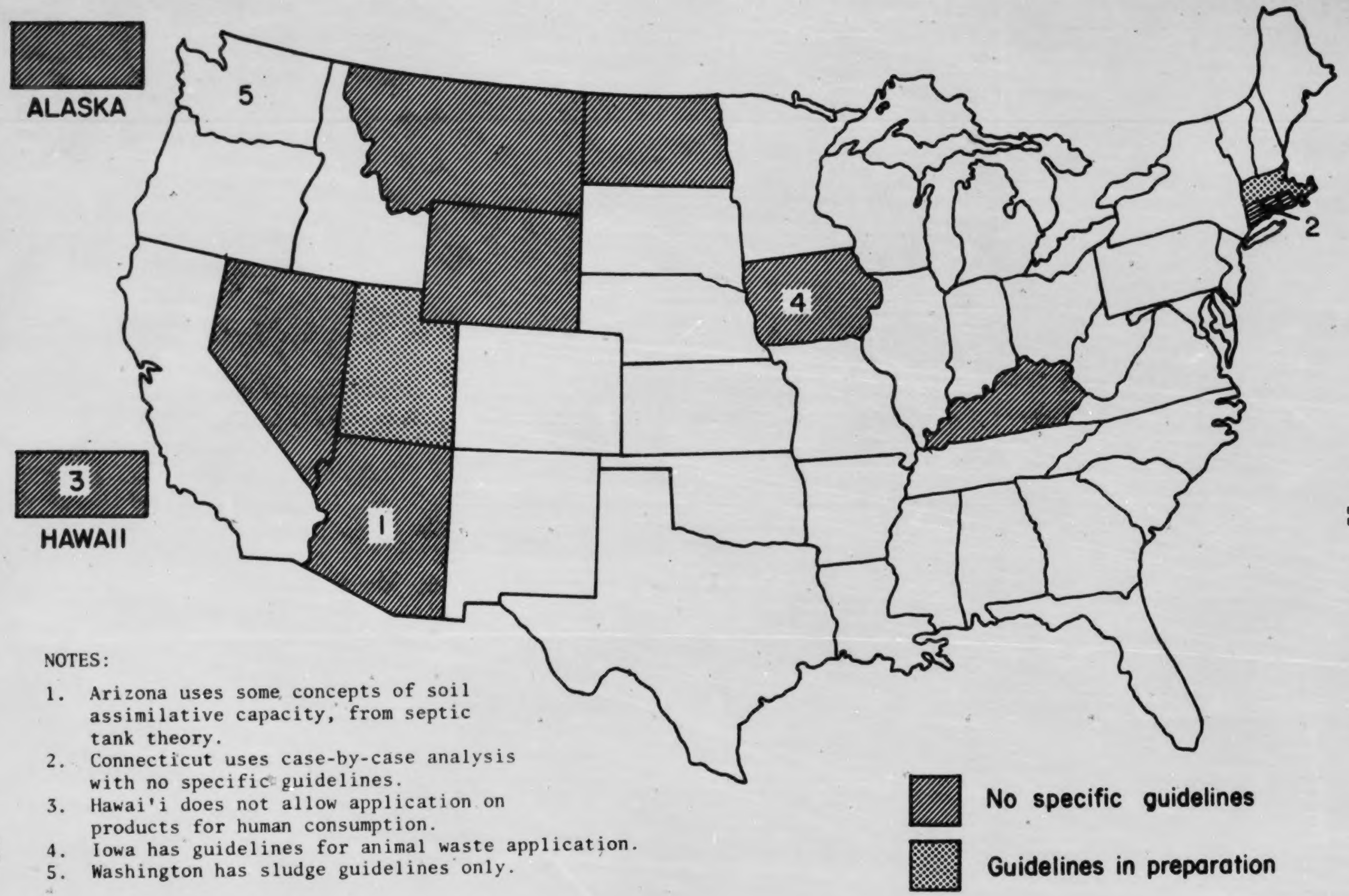
A study was conducted in order to ascertain current state regulations and guidelines for the practice of applying wastewaters and sludges to land.

In preparing this module, a survey was undertaken to gather more current information for this program (Morris and Jewell, 1976). The major objectives of the study were to evaluate the extent to which land application is regulated at the state level and the trends which states are following in developing their guidelines. A familiarity with the requirements of different states should give participants a perspective on the kinds of regulations, the variability in the regulations, and the need to address the design of land application systems in different states on an individual and specific basis. The study involved contacting the pollution control agency of each of the fifty states by mail. A copy of current regulations and guidelines for the practice of applying wastewaters and sludges to land was requested. A space was provided where personnel could indicate if their state has no guidelines.

All fifty states responded to the survey. Several sent information applicable to waste management guidelines in general, but not specific to land application. Only the states which sent guidelines specifically for land application of wastes are included in the following discussion.

Twenty-four states did not have regulations or guidelines for land application in 1976. Of these, five states were preparing guidelines. This tabulation was updated in 1977, revealing the situation shown in Figure 1. Only eleven states still had no specific land application guidelines, which indicates the rapid development of this regulatory concern. Two other states have regulations in preparation.

A glance through a selection of state guidelines for land application of wastes indicates that certain aspects of this waste management alternative have received more regulatory attention than others.



NOTES:

1. Arizona uses some concepts of soil assimilative capacity, from septic tank theory.
2. Connecticut uses case-by-case analysis with no specific guidelines.
3. Hawai'i does not allow application on products for human consumption.
4. Iowa has guidelines for animal waste application.
5. Washington has sludge guidelines only.

Figure 1. Status of state land application regulations - 1977.

It is helpful to categorize regulations and guidelines into three parts: System Design, Pre-Application Water Quality, and General Information.

Guidelines pertaining to System Design include the following:

- Loading rate
- Application system
- Buffer zone
- Monitoring
- Cover Crop
- Storage
- Public access
- Effluent quality

Pre-application water quality factors include:

- Pretreatment requirement
- Five-day biochemical oxygen demand (BOD_5)
- Solids
- Toxic elements
- pH
- Dissolved oxygen (DO)
- Nitrates
- Organics
- Chlorine residual
- Coliform concentration

Information on state regulations and guidelines was categorized as to system design, pre-application water quality, and general information.

General information on regulations and guidelines includes:

- Type of waste applied
- Philosophy and major concern of state
- Site characteristics
- Factors which prevent land application
- Weather restrictions

There is a wide range in the number of areas states choose to regulate. In some cases emphasis may be placed on only one or a few areas. For example, Michigan has very specific monitoring guidelines, which are relied on to protect the groundwater. On the other hand, some states such as Florida have regulations or guidelines for nearly all the factors listed above.

Relatively few states had legislated regulations for land application systems as of 1977. In most cases, the states issued guidelines which must be used when designing a land application system. The design is then submitted to the appropriate agency in the state. That agency then evaluates the design on a case-by-case basis in terms of the guidelines developed by the state.

Most states have issued guidelines rather than regulations set by law.

The guidelines and regulations of several states are either in draft form or have been updated. It is important, therefore, to check with the appropriate state agency (in most cases the health or environmental protection agency) to get the most recent state regulations and guidelines. See Appendix G for the agency to contact in each particular state.

Several states have based their guidelines either wholly or in part on the standards developed by the Great Lakes - Upper Mississippi River Board of State Sanitary Engineers. Originally known as the Ten State Standards, these guidelines were developed to be used as a guide for design and preparation of plans for sewage treatment works. They represent an attempt at establishing an amount of uniformity of practice among the participating states. The text of the pertinent material is included in Appendix H.

The Ten State Standards are used by several states as the basis for their guidelines for land application of wastes.

The GLUMRB standards place a great deal of emphasis on the design report. This report allows the agency to evaluate the proposed site for suitability to land application. In many cases, a consultant should be engaged to fulfill the requirements for detailed geology, hydrology, and soils information.

Information on adjacent land use is important in evaluating the impact of the land application site on the surrounding community. The site should be compatible with both existing land use and with planned future development.

The GLUMRB standards require the equivalent of secondary treatment in most cases. As we shall see, this is required by nearly all the states which have issued guidelines or regulations for land application of wastes.

Figure 2 shows several aspects of land application systems which are addressed by many of the states. In designing these systems, the engineer should be

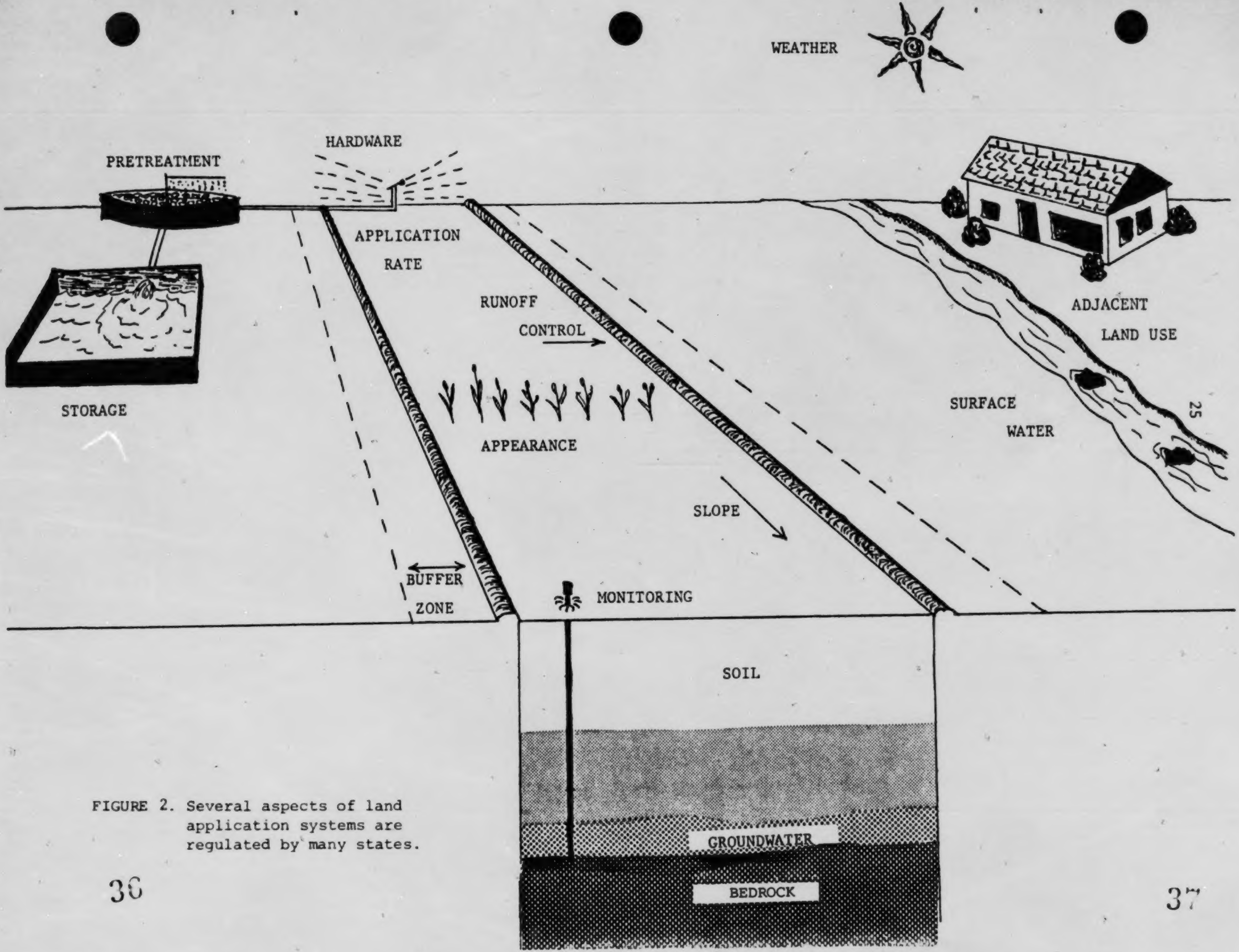


FIGURE 2. Several aspects of land application systems are regulated by many states.

aware of requirements for pretreatment, storage capacity, type of hardware, extent of buffer zone, application rate for waste, appearance of the site, runoff control, slope of the site, soil, bedrock, hydrology of the site, monitoring program, and adjacent surface water and land use. Several states prohibit waste application during certain weather events.

Trends in State Guidelines

In reviewing state guidelines for land application, several trends can be observed. This is in part due to the fact that many of the states which have developed guidelines have used similar reference materials. The Great Lakes-Upper Mississippi River Board Addendum #2 is one such widely used reference. A second is the EPA publication entitled Evaluation of Land Application Systems (EPA, 1975). This publication presents information on preparing wastewater management plans, design plans and specifications, and operation and maintenance manuals.

Most states require that wastewater or sludge receive secondary treatment prior to land application. This requirement has a large influence on how cost-effective land application will be as waste treatment alternative.

One nationwide trend has special significance to the future of the land application alternative. This is the requirement which 18 out of 26 states mandate -- that is, secondary treatment of waste prior to application to land. The states which require pretreatment of or equal to secondary treatment are shown in Table 1. The importance of the secondary treatment requirement to the future of land application lies in the emphasis placed by EPA on treatment alternatives which are cost-effective. It is difficult to design a land application system with a secondary plant for pretreatment, while remaining within the bounds of cost-effectiveness.

The requirement for secondary treatment stems from the differing views held among waste management personnel towards land application as a waste treatment mechanism. The states which require secondary treatment tend to view land application as a means of disposing of wastewater. The states which do not require pretreatment consider the soil itself to be a treatment medium, recognizing the renovation capabilities of the soil.

In a memorandum dated October 3, 1977, EPA Administrator Douglas Costle announced an EPA policy directive which may change the states' position on pretreatment requirements. The memo reads, in part, "Imposition of stringent wastewater treatment requirements prior to land application has quite often nullified the cost-effectiveness of land treatment processes in the past ... Whenever states insist upon placing unnecessarily stringent pre-application treatment requirements upon land treatment, such as requiring EPA secondary effluent quality in all cases prior to application to the land, the unnecessary wastewater treatment facilities will not be funded by EPA." The full text of Mr. Costle's statement appears as Appendix J of this module.

New EPA policy will deny funding to states for "Unnecessary" pretreatment requirements for municipal land application projects.

Table 1. States that required secondary treatment prior to land application.*

California[1]
Colorado
Delaware
Florida
Georgia
Illinois
Minnesota
Missouri
New Hampshire
New Jersey
New York
Ohio
Oregon[2]
Pennsylvania
South Carolina
South Dakota
Texas
Vermont
Virginia
West Virginia
Wisconsin

[1] Pretreatment requirement depends on intended use of water

[2] Requires water quality of 20 mg/l BOD_5 and 20 mg/l suspended solids

*(Morris and Jewell, 1976)

In evaluating land application sites, several factors automatically eliminate a site from considera-

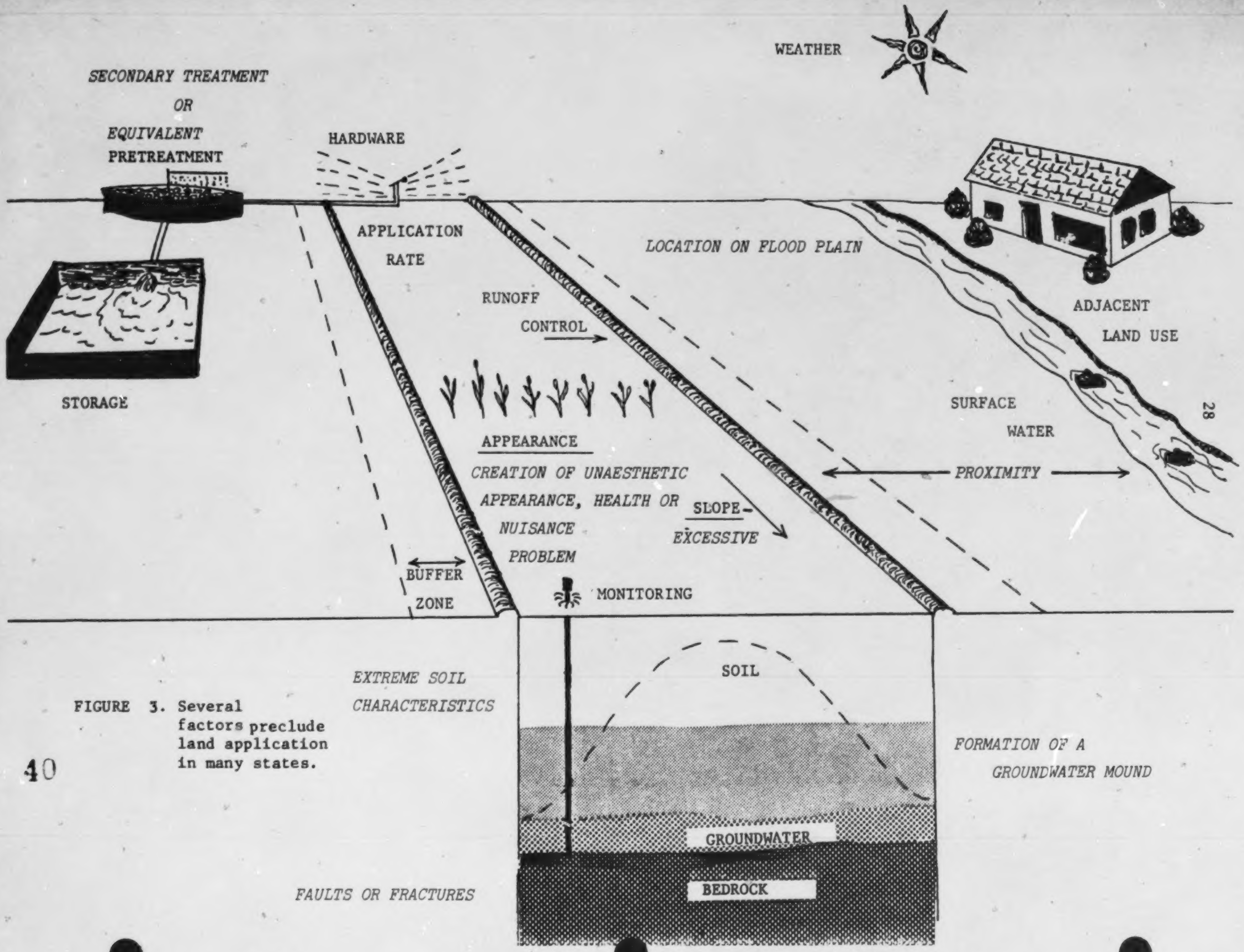


FIGURE 3. Several factors preclude land application in many states.

tion in most states (Fig. 3). These factors include:

1) Possibility of creating a groundwater mound close to the soil surface
2) Excessive slope of land
3) Proximity of site to surface waters or drainage ditches which could be contaminated by runoff
4) Location of site on a flood plain
5) Extreme soil characteristics, such as high rate of permeability
6) Faults or fractures in the underlying bedrock
7) Creation of an eyesore, health problem, or nuisance on the site or on adjacent property.

Several factors may eliminate land application as an option at a particular site in many states.

Four other areas of land application receive attention from a majority of states (Fig. 4). Nearly 50% of the states require that land application sites incorporate methods to control surface runoff, and to prevent off-site runoff from flowing onto the site. Ditches and berms are the most commonly used method of runoff control. Additionally, erosion from these sites must be controlled.

The slope of the site is an important consideration in land application. Generally the slope for cultivated fields which are irrigated with wastewater should be no greater than 4%. For sodded fields, up to 8% slope is typically suggested. For year-round application to forested slopes, some states require a slope no greater than 8%, while others allow this operation on slopes up to 20%. Seasonal operation on terraced, forested land is allowed on slopes of up to 25% in New Jersey, although most other states limit this practice to slopes under 15%.

Runoff control, slope of site, weather restrictions, and monitoring programs are specified by a majority of the states.

Operation of land application systems is required to cease under severe weather conditions in several states. In these states, irrigation should not be carried out during or after heavy rainstorms. Irrigation must cease in winter in Missouri and

Nebraska. New York, Minnesota, New Hampshire, and South Dakota limit the irrigation season to 18-20 weeks per year, effectively eliminating the option of winter irrigation. States which allow winter irrigation often require that 1) pipes be capable of being drained to prevent freeze-up, 2) runoff from snow or ice build-up be controlled, and 3) irrigation is stopped when the land is frozen or snow-covered. This last requirement pertains to Maine, Virginia, and West Virginia.

Monitoring guidelines are set by 85% of the states. The majority of these stipulate that at least one monitoring well be placed in each direction of major groundwater flow. Several states, however, specify which parameters are to be analyzed, where wells are to be located, frequency of sampling, and equipment checks.

The majority of states stipulate that land application systems must be monitored with at least one monitoring well to be placed in each direction of major groundwater flow.

When states develop guidelines and regulations for land application, they may base sections on existing guidelines or regulations for other aspects of environmental protection. For example, water quality criteria established for flowing surface waters of the state may be used when determining the level of effluent quality required from a land application system. It is therefore necessary for the design engineer to consult with officials of the state pollution control agency to identify existing regulations which may affect land application system design.

Regulations or guidelines for land application of wastes may coincide with other pollution controls or health regulations of the state.

Whereas most states have issued guidelines for the design and operation of land application systems, other states have published formal regulations. The states which have regulations rather than the more informal set of guidelines include California, Delaware, Idaho, Kansas, Missouri, Oregon, and Vermont. In several cases, these regulations are part of the health legislation of

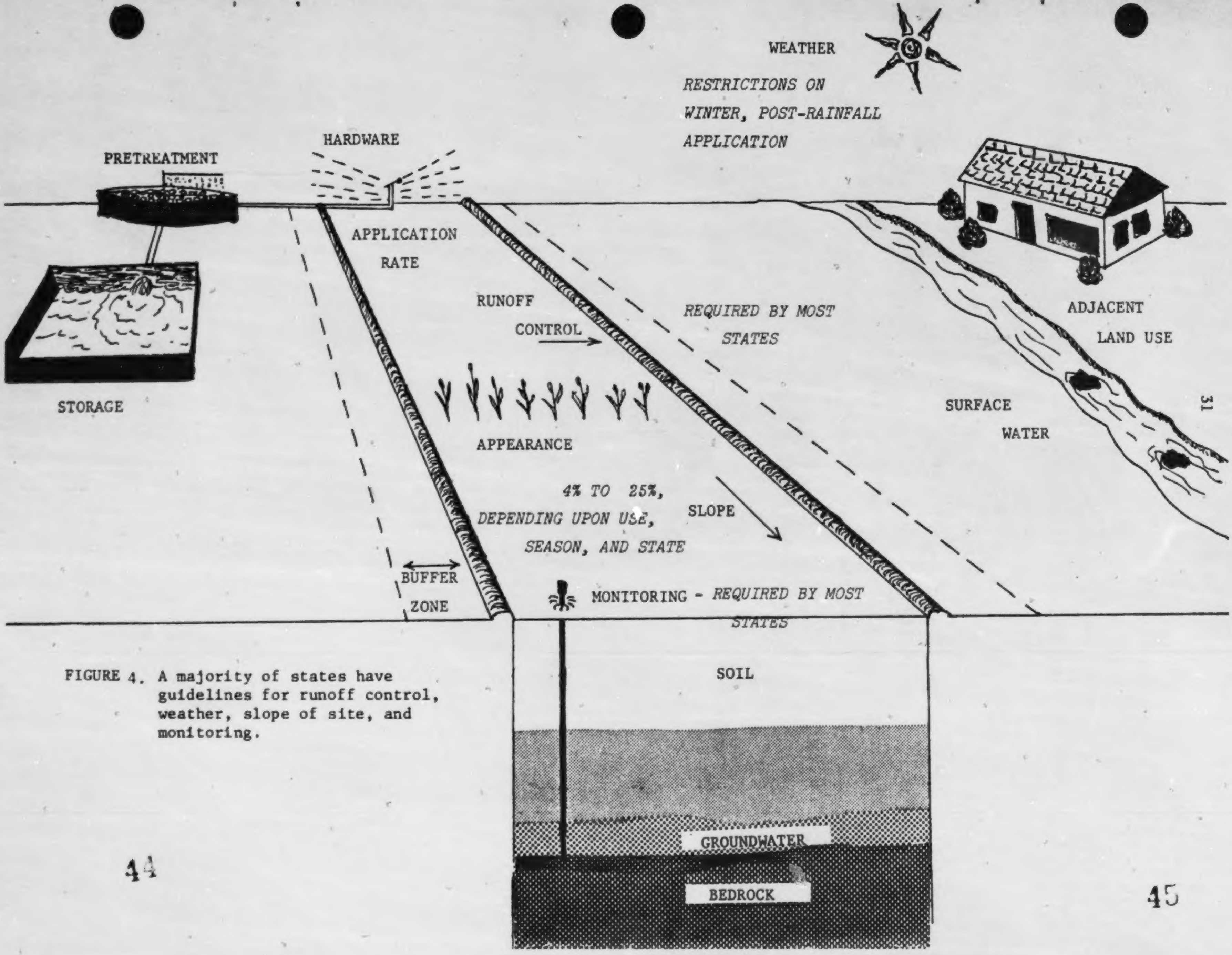


FIGURE 4. A majority of states have guidelines for runoff control, weather, slope of site, and monitoring.

the state. In states which have guidelines, the design engineer is expected to use the guidelines when developing the system design. He then submits the design to the appropriate agency, which approves or denies it. Several states, including those which have neither regulations nor guidelines, stress that permits for land application systems will be granted on a case-by-case basis. In light of the realities of the land application alternative this is the most sensible approach, since each land application site will be essentially unique in terms of soils, underlying bedrock, geology, hydrology, and so forth.

Table 2. Recommended site characteristics required by various states for land application of wastes as of 1976.

Slope Guidelines

	None Given	Dependent on Cover Crop	Maximum Allowable Slope	Minimum Depth to Groundwater in Feet (Not Underdrained)
California	x			
Colorado	x			
Delaware	x			2
Florida			5%	5[2]
Georgia		Yes	20%	10
Idaho	x			
Illinois		Yes[1]	14%	5-10[3]
Kansas	x			
Maine			8%	
Michigan	x			
Minnesota			2%	10[4]
Missouri			2%	
Nebraska		Yes		5
New Hampshire			10%	
New Jersey		Yes	25%	
New York		Yes	14%	
Ohio			12%	
Oregon	x			
Pennsylvania		Yes[1]	14%	10
South Carolina		Yes	20%	5[4]
South Dakota	x			6
Texas	x			
Vermont			25%	
Virginia			15%	5
West Virginia		Yes[1]	14%	
Wisconsin	x			

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[1] Slope guidelines are 4% for irrigation of cultivated fields, 8% for irrigation of sodded fields, 8% year-round irrigation on forested areas, and 14% on seasonal irrigation of forested areas.

[2] Except for recharge basins where a minimum depth of 18" is required.

[3] Dependent on infiltration rate of soil.

[4] Where underdrains are installed, minimum depth to groundwater 4'.

Table 3. Summary of several common aspects of state guidelines for land application of wastewater which have major impact on the final design. (Results of 1976 survey) (NI - no information given)

State	Storage Requirement	Buffer Zone Requirement	Cover Crop	Hardware	Loading Rate (Max. in/ac-wk)
California	NI	500' to water supply wells	NI	Maximum attainable separation	NI
Colorado	NI	NI	NI	NI	NI
Delaware	Reserve area required	200'	Crop planted before irrigation begins	Minimize aerosol formation	Not to exceed infiltration rate
Florida	7 day flow plus 3' freeboard	150' to houses 200' to water wells	Crop planted before irrigation begins	Minimize aerosol formation	4
Georgia	30 days design flow	At least 300'	Woodlands or non-food crop	Fixed distribution system	1
Idaho	NI	NI	NI	NI	NI
Illinois	To accommodate flows in excess of irrigation	150' to water supplies; 200' to surface water	NI	Stationary systems capable of being drained	NI
Kansas	NI	NI	NI	NI	NI
Maine	NI	300' for spray irrigation	No application on bare soil	NI	NI
Michigan	NI	NI	NI	NI	NI
Minnesota	210 days	To extent possible	Acceptable vegetative cover	Minimize aerosol drift; automatic shutoff during rain	2 (4 during July and August)
Missouri	Winter flow plus allowance for wet Spring	NI	Reed canary grass, tall fescue	Drains to prevent freeze-up	NI

Table 3. (Continued). Summary of several common aspects of state guidelines for land application of wastewater which have major impact on the final design. (Results of 1976 survey)

(NI - no information given)

State	Storage Requirement	Buffer Zone Requirement	Cover Crop	Hardware	Loading Rate (Max. in/ac-wk)
Nebraska	180 days	50'	NI	No cross connections between potable and reclaimed water pipes	3
New Hampshire	2/3 yearly flow	Site dependent	NI	NI	2
New Jersey	Site dependent	200'	No application on bare soil	Portable systems unacceptable	2
New York	To handle maximum reasonable variation in flow	Buffer zone required	Cover crop required; harvest when necessary	Station systems preferred	NI
Ohio	NI	NI	No application on root crops, leafy vegetables	NI	NI
Oregon	Adequate storage	NI	No irrigation of crops for human or dairy cattle consumption	NI	NI
Pennsylvania	To handle maximum reasonable variation in flow	200'	Few restrictions	Fixed lines for winter irrigation; low spray trajectory	2
S. Carolina	3 days flow	100'	No application on bare soil or crops for human or grazing animal consumption	Drains to prevent freeze-up	2

Table 3. (Continued). Summary of several common aspects of state guidelines for land application of wastewater which have major impact on the final design. (Results of 1976 survey) (NI - no information given)

State	Storage Requirements	Buffer Zone Requirement	Cover Crop	Hardware	Loading Rate (Max. in/ac-wk)
S. Dakota	210 day flow	To extent possible	"Suitable"	Minimize wind drift and aerosol formation	2
Texas	NI	500' to water supplies	No irrigation of food crops for raw consumption	No cross connections between potable and reclaimed water pipes	NI
Vermont	April-May flows	100' to surface waters	NI	Pump system must deliver daily flow within 8 hours	2
Virginia	60 days	200' for forested site; 600' for open site	No irrigation of food crops for raw consumption	Permanent spray system	2
W. Virginia	60 days	400'	NI	Permanent spray system, drains to prevent freeze-up	1
Wisconsin	NI	1,000' from public water supplies	NI	Minimize runoff, incorporate sludge	NI

Representative Guidelines

It would be unwieldy to attempt to present all the guidelines which states across the country have developed to regulate land application of wastes. Therefore, the following discussion of states' guidelines and regulations will proceed by examining the guidelines or regulations of one state from each of the five climatic zones of the contiguous United States. These zones are used here for two reasons: first, land application of wastes is directly affected by climate, and therefore regulations can be expected to vary from region to region; and second, because these climatic zones are also used in Module 14, "Case Studies", to discuss individual projects in terms of their geographic and climatic location.

Figure 5 is a map indicating the Climatic Zones as delineated by Pound and Crites (1973, p. 128). The representative states which will be discussed are as follows:

Region A: California
Region B: Texas
Region C: Florida
Region D: Pennsylvania
Region E: Minnesota

These states were chosen as representative examples because they have the most comprehensive guidelines or regulations within their regions. The guidelines and regulations described below are those that were obtained in the 1976 survey by Morris and Jewell.

Region A: California

In California the Board of Health is responsible for regulations controlling the use of reclaimed wastewater for irrigation. Regulations for the use of sewage sludge on agricultural land are in preparation.

Waste discharge requirements for wastewater or sludge applied to land are determined on a case-by-case basis. These regulations, which take into account existing pertinent legislation, are oriented toward protecting the waters of the state.

Two pieces of legislation form the basis for California's regulations for land application of wastes. The Porter-Cologne Water Quality Control Act of 1974 establishes the waste discharge requirements for land application of wastes. Wastewater Reclamation Criteria (California, 1975) describe allowable uses for primary and secondary wastewater. In addition, the Department of Health has issued a document entitled Guidelines for the use of Reclaimed Water for Spray Irrigation of Crops (California, 1974).

The guidelines for land application of wastes in California are particularly interesting because of the extensive use of primary-treated wastewater in that state for irrigation.

Surface irrigation of food crops may utilize water that has been disinfected and oxidized. Disinfection is considered adequate if at some point in the process the median number of coliform bacteria does not exceed 2.2 per 100 ml. for the last 7 days for which analyses have been completed.

Reclaimed water with quality equivalent to that of primary-treated effluent may be used for surface irrigation of orchards and vineyards as long as the fruit does not come in contact with the irrigating water on the ground.

Figure 6 indicates the design criteria established in California.

Food crops which are processed in such a way as to destroy pathogens before consumption may also be irrigated with primary effluent. Before such irrigation commences, however, permission must be granted by the Department of Health. To date, the

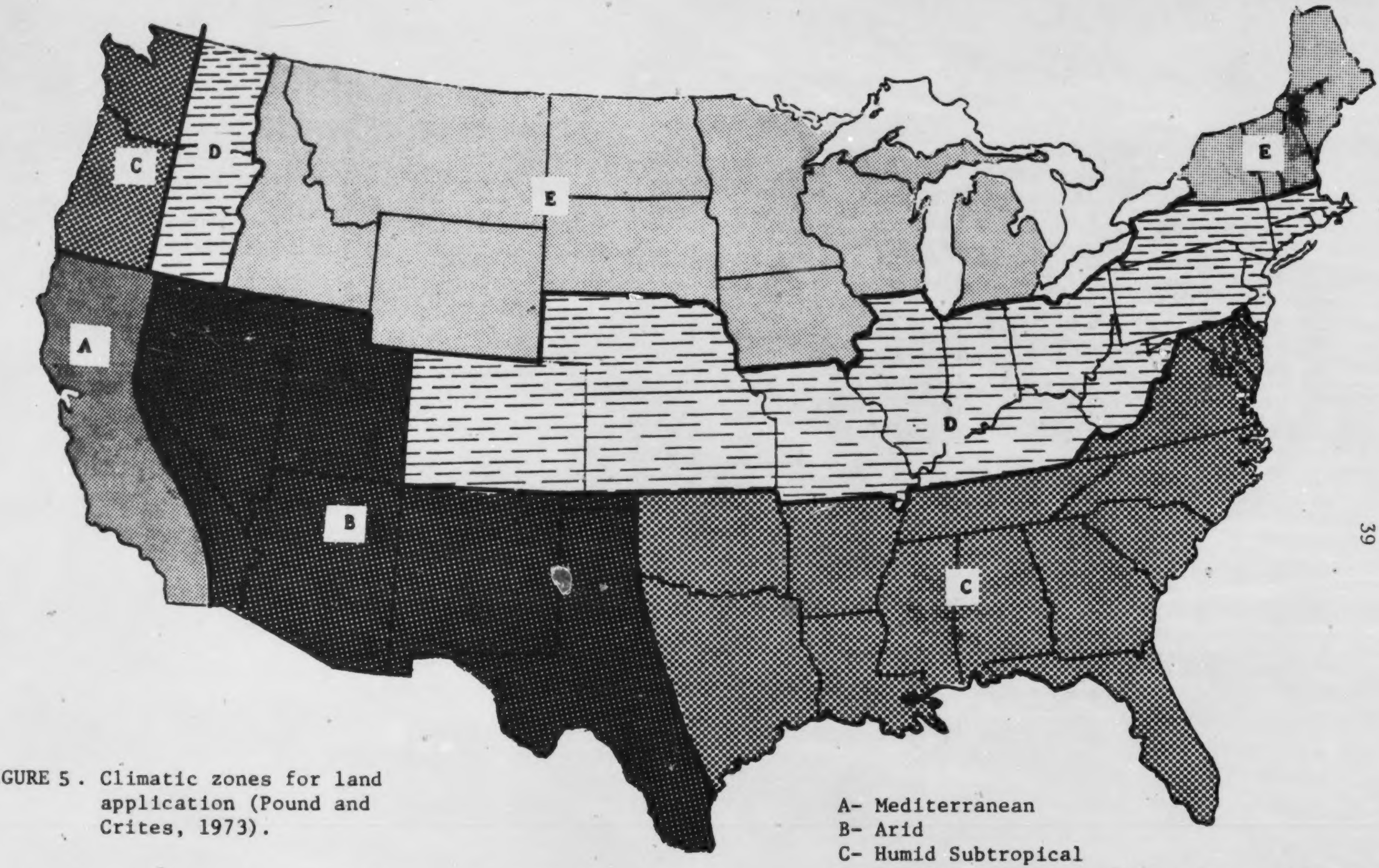

FIGURE 5 . Climatic zones for land application (Pound and Crites, 1973).

A- Mediterranean
B- Arid
C- Humid Subtropical
D- Humid Continental; Short winter, hot summer
E- Humid Continental; Long winter, warm summer

Public Health Department has discouraged all such uses. Table 4 summarizes water quality required for various uses in California.

TABLE 4

Water Quality Criteria for Reclaimed Wastewater in California are Dependent Upon Ultimate Use of the Water

Water Quality Requirement	Ultimate Use
Equivalent to primary-treated	1. Surface irrigation of orchards, vineyards 2. Food crops which are to be processed[1] 3. Surface or spray irrigation of fodder, fiber and seed crops
Disinfected, oxidized	1. Surface irrigation of food crops[2] 2. Irrigation of pasture for dairy animals[3] 3. Restricted recreational impoundment (non-contact water sports)[2] 4. Landscape impoundments
Disinfected, oxidized, clarified, filtered	1. Spray irrigation of food crops[4] 2. Non-restricted recreational impoundments (contact water sports)[4]

---

[1] Requires permission from Department of Health

[2] Requires median of 2.2 coliform organisms per 100 ml.

[3] Requires median of 23 coliform organisms per 100 ml.

[4] Requires median of 2.2 coliform organisms per 100 ml; no more than 23 coliform organisms per 100 ml. in any 30-day period.

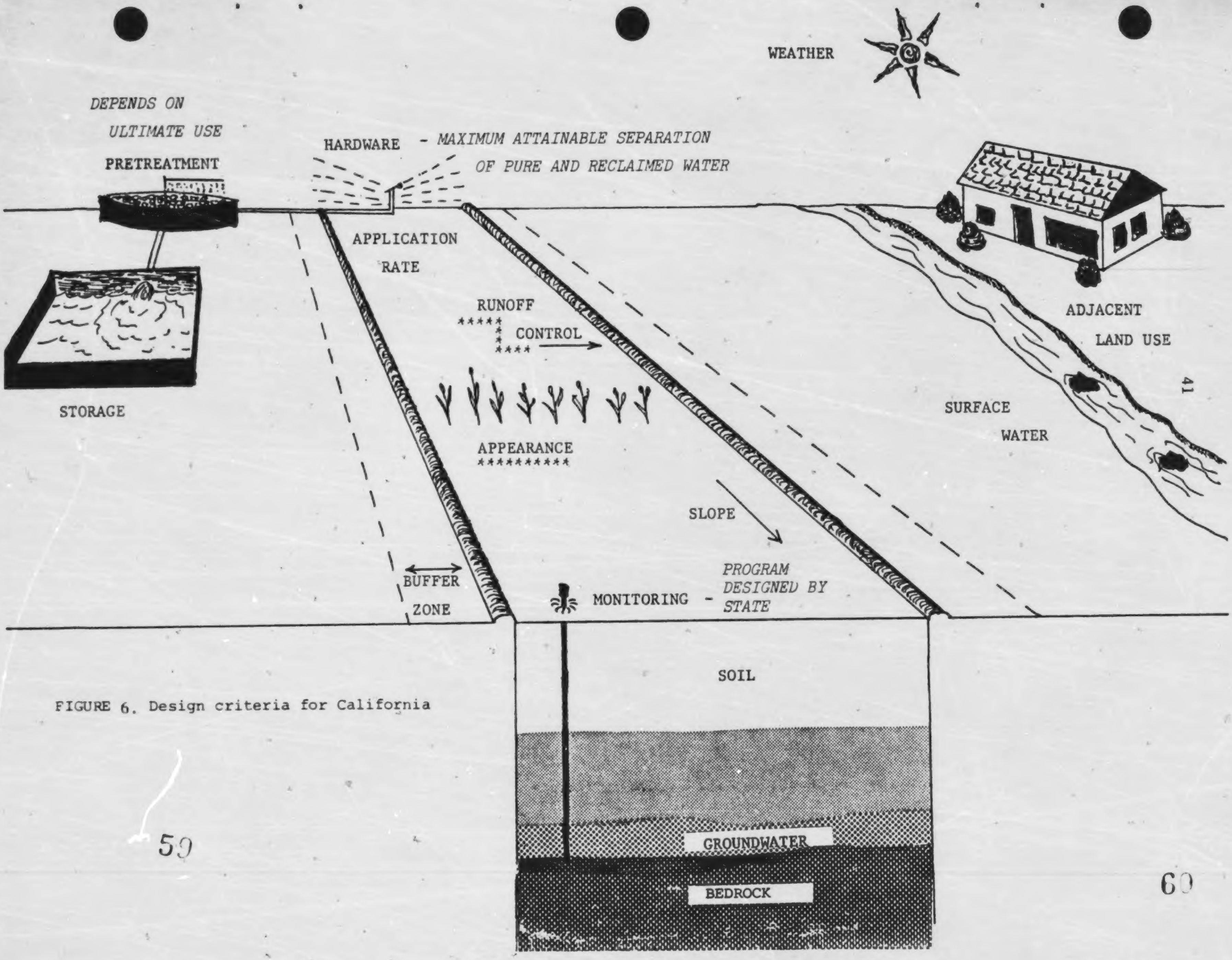

FIGURE 6. Design criteria for California

In designing the system, water lines for domestic water and reclaimed water should have maximum attainable separation. Valves and outlets on the reclaimed water lines should be operated only by authorized personnel.

The discharge resulting from irrigation must be confined to the site. Runoff must be contained and properly disposed of. The system shall not lead to the creation of unappealing slimes or odors. Ponding should be minimized, and the breeding of insect disease vectors controlled.

The monitoring regimen is decided by the state. In most cases,samples for suspended solids and coliform are to be collected daily. For uses which require secondarily-treated wastewater, analysis for coliform and turbidity, using a continuous recording turbidometer, is required.

Where primary wastewater is used, the site should be fenced. For spray sites, windblown spray should not be allowed to reach areas which are accessible to the public. Drinking fountains must be protected from windblown spray. If wastewater is used at golf courses, notice of its use shall be given on scorecards and at water hazards on the golf course. Qualified supervision is required at recreational impoundments. Wastewater is not to be spread on roads, walkways, picnic tables, or other areas not under control of the user.

When wastewater is used for irrigation, enough time should pass between the final irrigation and harvesting to allow the crops and soil to dry. Irrigated areas should be thoroughly dry before grazing animals, particularly dairy animals, are released on them. Measures to prevent direct contact between edible portions of the crop and the reclaimed water shall be taken.

Guidelines for the use of wastewater differ depending on the ultimate use of the water.

California has been using reclaimed wastewater for a comparatively long time. Several projects in the state are of particular interest. Three of these, at Bakersfield, Fresno, and Santee, are examined in Module 14, "Case Studies". The latter project utilizes wastewater for extensive recreational facilities including swimming. Bakersfield and Fresno apply the wastewater to crops.

Table 5. Summary of design criteria for land application of wastes in California

Parameter	Guidelines
Major concern	Protection of waters of state
Pretreatment	Depends on ultimate use
Runoff control	Discharge confined to site
Hardware	Maximum attainable separation of reclaimed and domestic water lines
Buffer zone	At least 500' from water wells, reservoirs
Monitoring	Dependent on water quality
Cover Crop	Dependent on water quality
Public access	Dependent on water quality

Region B: Texas

Although only the Western part of Texas falls within Climatic Zone B, it will be discussed here, as none of the other states of Region B - Utah, Arizona, or New Mexico - have guidelines or regulations specifically for land application of wastes. Indeed, Region B also includes the southeastern part of California, although the majority of California takes up the entire area of Region A.

Figure 7 indicates design criteria of Texas

The main concern in Texas is protection of

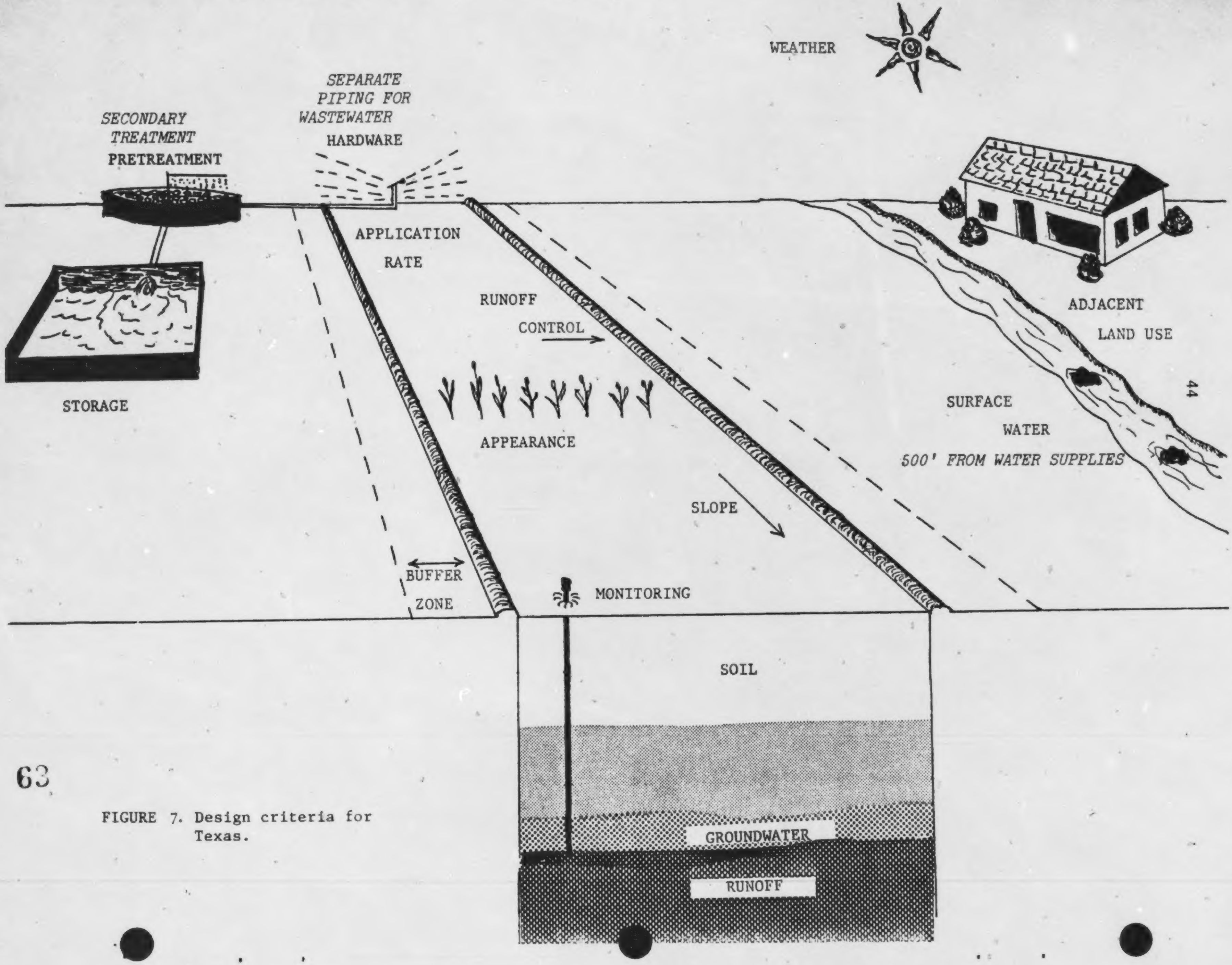

FIGURE 7. Design criteria for Texas.

public health. Secondarily-treated wastewater is often used for irrigation of isolated pastures. Crops not used for human consumption may be irrigated with water that has received secondary treatment; in this case chlorination is recommended. Crops used for human consumption may not be irrigated with reclaimed wastewater. Golf courses and other areas where public access is controlled may use wastewater for irrigation; however, irrigation should be practiced only when these areas are closed to the public.

The guidelines of Texas are aimed at protecting the public health.

The pipes carrying treated wastewater may have no physical contact with pipes carrying drinking water. Additionally, all outlets, pipes, and valves on the wastewater lines must be identified. Wastewater to be used for irrigation at areas accessible to the public should achieve the quality criteria presented in Table 6.

TABLE 6

Wastewater used for Irrigation in Public Access Areas in Texas Must Meet Strict Secondary-Treatment Standards

Constituent	Concentration
BOD_5	20 ppm
SS	20 ppm
Fecal coliform	50 MPN/100 ml
Cl residual	2.0-5.0 ppm for 20 minutes at peak flow

Digested sludges may be applied to pastureland if public health nuisances have been eliminated.

Wastewater and sludge application sites must be at least 500' from drinking water wells or water supply treatment plants.

Region C: Florida

The draft guidelines established by Florida for the application of municipal wastewaters to land attempt to protect the water in receiving streams and safeguard the health, safety, and welfare of the public. Florida is one of the few states which views land application as a treatment means, rather than merely as a disposal method. The effluent from the land application site must be compatible with that of local ground and surface waters.

Land application systems in Florida are viewed as a long term, cost-effective, and viable alternative method for meeting discharge limitations and water quality standards and should be designed as such.

Florida prohibits the use of wastewater for the irrigation of food crops for human consumption which may be eaten raw or without processing which is sufficient to destroy any associated pathogens.

The requirement for secondary treatment is applicable to all land application projects. Other criteria listed in Table 7 may be altered by the state, depending on site-specific considerations.

Figure 8 indicates design criteria for Florida.

Although Florida considers land application to provide some amount of treatment for the waste, the state still requires that wastewater receive secondary pretreatment prior to land application.

TABLE 7

Guidelines for land application
of municipal wastewater in Florida

Parameter	Guideline
Slope	Not to exceed 5%
Runoff	A berm and perimeter ditch built to contain storm runoff, prevent direct discharge to surface water
Cover Crop	To be planted before irrigation begins
Buffer Zone	Site must be 150' from existing or potential residential areas, 200' from water. A peripheral buffer zone of trees or deep-rooted vegetation shall enclose the site.
Storage	7-day design flow plus 3' freeboard
Reserve Area	25% of required spray area excluding buffer zone
Spray Technique	Minimize aerosol formation
Monitoring	Require background quality. Test for pH, BOD, coliform, N, NO_3-N, P, TDS, hardness, chloride at least one groundwater monitoring well in each major direction of groundwater flow. Samples to be collected from different depths of water table.
Piping	No cross connections with potable water supply. Irrigation system, drains, dikes and storage basin to be designed according to applicable engineering standards
Public Access	Fences to keep out livestock and trespassers; post warning signs; areas with public access to be irrigated at night

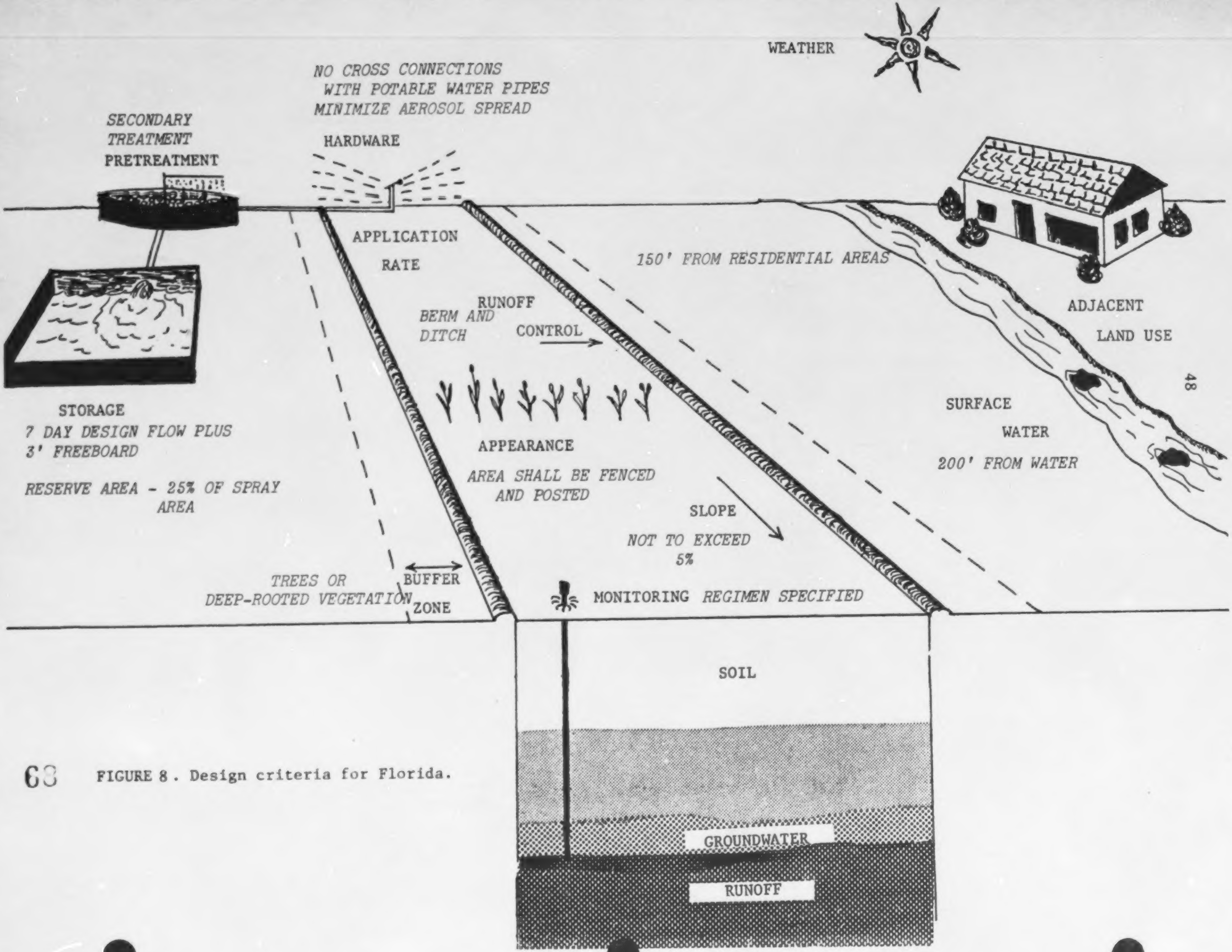

FIGURE 8. Design criteria for Florida.

Pre-application effluent quality required is dependent upon the application rate and the use of the water. This information is presented in Table 8.

TABLE 8

Pretreatment Requirements in Florida are Dependent on Application Rate and Use of Water

Type of Dispersal or Recharge	Pretreatment Before Holding Basin
Low rate land spreading (irrigation & crop harvesting)	Secondary treatment & chlorination. BOD$_5$ $\leq$ 20 ppm. SS $\leq$ 20 ppm. Total N $\leq$ 25 ppm. Total P $\leq$ 10 ppm
High rate land spreading (irrigation & crop harvesting)	Secondary treatment & mixed media filtration. BOD$_5$ & SS $\leq$ 10 ppm. Total N $\leq$ 10 ppm. Total P $\leq$ 10 ppm. Breakpoint chlorination. Free residual chlorine of 1.0 ppm after 15 min. contact at maximum flow
Recharge Basins	Advanced waste treatment BOD$_5$ & SS $\leq$ 5 ppm. Total N $\leq$ 3 ppm. Total P $\leq$ 1 ppm*. Breakpoint chlorination. Free chlorine of 1 ppm after 15 min. contact or maximum flow

*Phosphate removal may not be required if there is no likelihood of phosphorus enrichment of surface waters in the vicinity.

Note: Groundwater monitoring is required for all projects.

Region D: Pennsylvania

Pennsylvania has produced the Spray Irrigation Manual (Pennsylvania, 1972) which describes guidelines for locating and designing spray irrigation sites. It also includes a handbook which, upon completion by the engineer, becomes part of the required design report.

Figure 9 indicates design criteria for Pennsylvania.

All spray irrigation systems are considered to be discharges to waters of the state. Therefore, such systems will require a permit from the Pennsylvania Department of Environmental Resources.

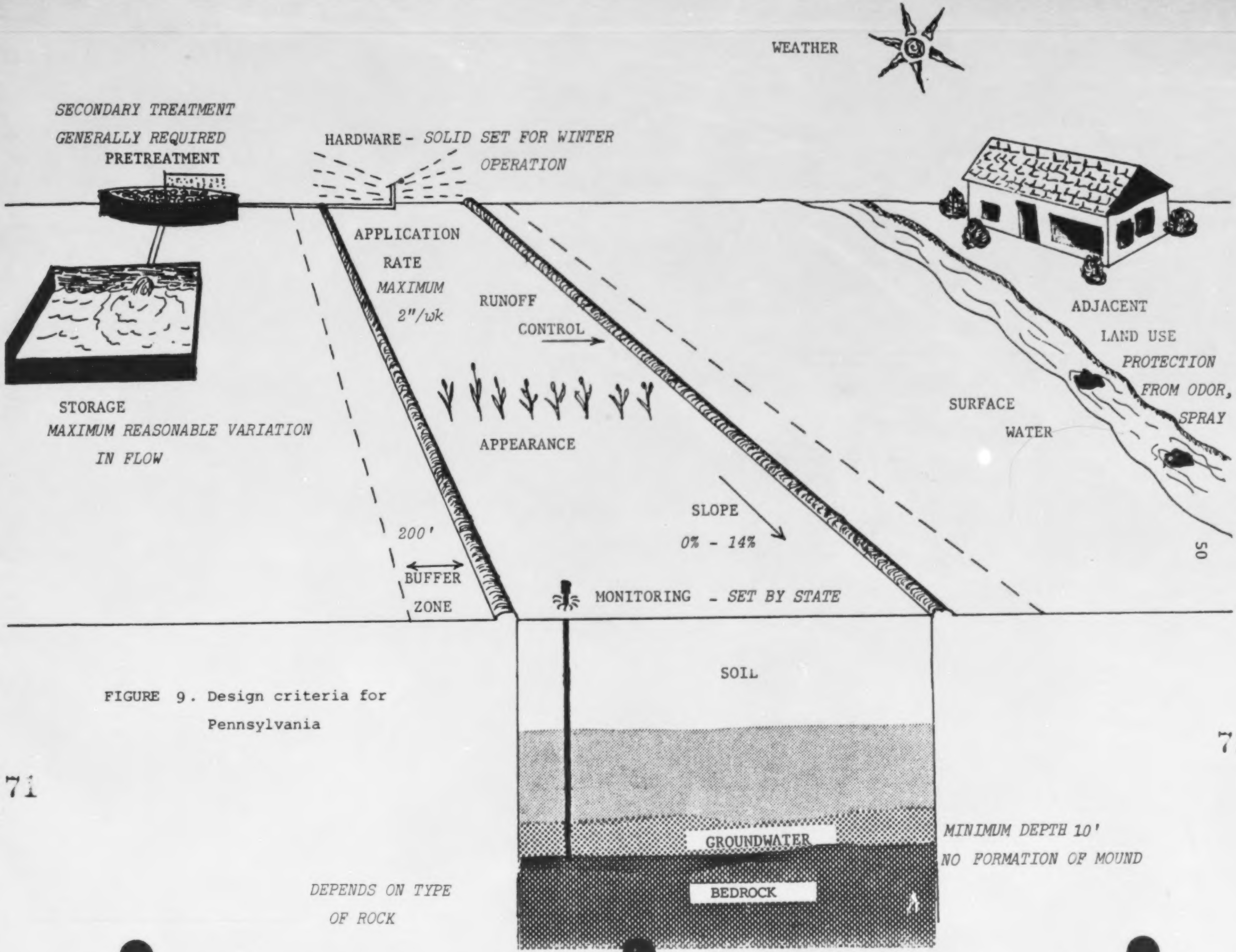

FIGURE 9. Design criteria for Pennsylvania

The soil mantle is viewed as a treatment mechanism. Only waste constituents which can be treated successfully by the soil may be applied. Even so, secondary treatment is generally required prior to land application.

Pennsylvania views the soil as a treatment mechanism, but still requires secondary pretreatment of wastewater.

Irrigation should be restricted to a once-per-week application. This regimen allows the soil to dry out and re-aerate, thereby promoting the conditions necessary to continue waste degradation. The soil itself should provide for a slow but continuous downward movement of wastewater. This slow percolation allows adequate detention time in the soil matrix needed for the waste-degrading reactions to occur. The Hublersburg clay loam at the Penn State research site is typical of this type of slowly-permeable soil.

Pennsylvania has developed the following recommendations for application rates for spray irrigation of secondarily-treated wastewater (Table 9).

TABLE 9

Pennsylvania has Varied Recommendations for Spray Irrigation of Wastewater

Site Characteristics	Recommended Maximum Application Rates (inches/week)			
	Spring	Summer	Fall	Winter
Soil rapidly to moderately permeable; deep to well-drained	2	2	2	2
Soils rapidly to moderately permeable; moderately deep, well-drained	1.5	1.5	1.5	1.5
Moderately to very slowly permeable soils, moderately well drained with seasonal high water table	Unacceptable	2	2	Unacceptable
Bedrock at or near surface	Up to 2"/wk may be approved upon submission of relevant supporting data			
Flood plain soils		1.5	1.5	

The state has also issued guidelines pertaining to the underlying geology of the land application site. These guidelines appear in Table 10.

TABLE 10

Suitability of Underlying Rock for Land Application of Wastes in Pennsylvania

Rock	Suitability
Sandstones	Poorly consolidated sandstones and deeply weathered greywackes and arkoses are most suitable.
Shales	Usually a poor choice. While some are deeply weathered and provide adequate renovation, others may have open fractures that will allow flow of wastewater directly to groundwater, others are so tight they reject infiltrating water, form a perched water table and eventually lead to ponding.
Limestone	Sites are preferred where the soil cover is thick and bedrock ledges or pinnacles are well below surface. Where soils are thin and bedrock occurs near surface, addition of wastewater may cause accelerated sinkhole development and surface collapse.
Perched Water Table	An experienced geologist should supervise drilling in areas where these are known to occur.
Glacial Deposits	Extremely variable, but generally only marginally acceptable for spray irrigation. Some soils on moraine materials may be acceptable for seasonal operation at low application rates. Sands and gravels of outwash plains and valley fills generally unacceptable due to high permeability.

The extent of the required buffer zone is often a factor in design of land application systems. In Pennsylvania, a 200' buffer zone is required. In some cases the cost of land for buffer zones may be considerable.

The condition of the groundwater is also important in selecting a site for spray irrigation of wastewater. Usually, the maximum groundwater elevation should not exceed ten feet, and the formation of a groundwater mound should be avoided. Monitoring wells should be placed in each direction of major groundwater movement away from the site. In addition, one well should monitor the background quality of groundwater entering the site. Groundwater monitoring points may be natural springs or wells; in either case these monitoring points must provide adequate access and water flow for sampling at all times.

Pennsylvania requires a 200' buffer zone around the entire spray field. This may be a costly requirement for larger systems.

Chemical analyses from monitoring points are to be submitted quarterly. Required tests include phosphates, ammonia-nitrogen, nitrate-nitrogen, and methylene blue active substance. Other tests may be required by the Department of Environmental Resources.

Few limitations are placed on the choice of cover crop for the land application system. Idle fields, forests, grassland, and crop areas are acceptable. The cover crop chosen should provide a high rate of evapotranspiration, and should prevent erosion from runoff. The crop should be harvested and removed at least once a year, and more often if large amounts of nitrogen are applied. Standard agricultural practices for land application sites are acceptable for fields with slopes up to 4%. If a sod is the cover crop, fields with up to 8% slope may be used. For year-round application to forested areas,slopes up to 8% are acceptable. Seasonal irrigation may be practiced on forested slopes up to 14%.

If the irrigation facilities are not designed to handle surge flows or to operate during the winter, storage must be provided. The storage facilities should be able to handle the maximum reasonable variation in flow.

For year-round sprinkler operation, solid-set piping is recommended. Year-round irrigation may only be conducted in areas of permanent vegetation, preferably forest areas. Pipes should have drains to prevent freeze-up. Runoff from ice accumulation must be controlled. Adjacent land use should be protected from spray odor and degradation of groundwater. Trajectory of spray should be as low as possible to prevent aerosol spread.

Table 11. Summary of design criteria for land application of wastes in Pennsylvania

Parameter	Guidelines
Philosophy	Considers soil to be a treatment medium
Pretreatment	Secondary treatment
Runoff Control	Control runoff from ice build-up
Hardware	Fixed irrigation lines for winter operation. Drains to prevent pipe freeze-up. Trajectory of spray as low as possible.
Buffer zone	200' around spray field
Monitoring	One well in each direction of major underground flow; determine quality of groundwater entering site
Cover crop	Idle fields, forests, grasslands, crop areas
Storage	To handle maximum reasonable variation in flow
Slope	0-14% depending on cover crop
Application rate	Maximum 2 in./week
Groundwater depth	At least 10' to groundwater. No formation of groundwater mound

Region E: Minnesota

Minnesota has published recommended design criteria for land application of wastewater. Municipal effluents must receive secondary treatment prior to disposal on land. Industrial effluents may be exempted from this requirement. The water

Figure 10 indicates design criteria for Minnesota.

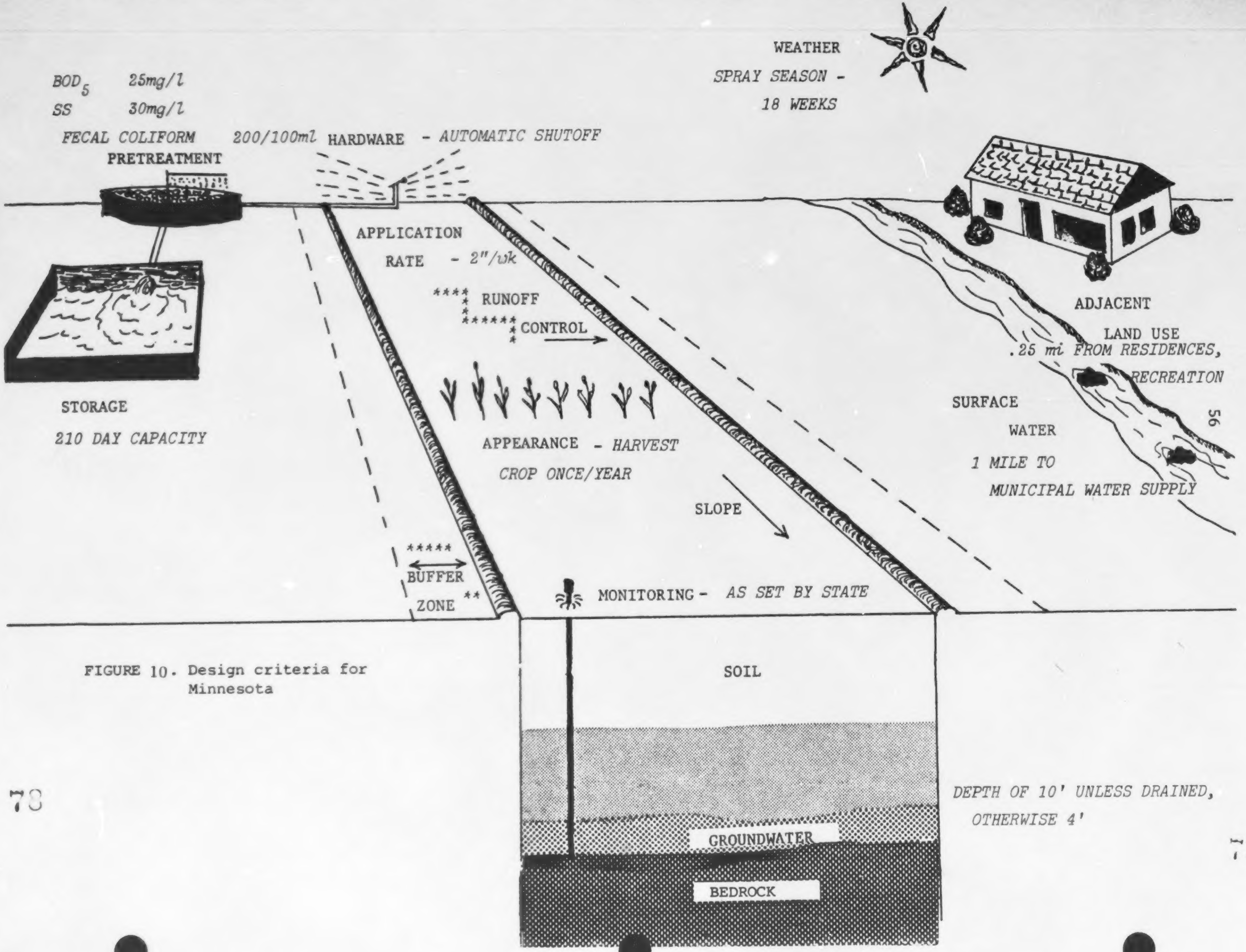

FIGURE 10. Design criteria for Minnesota

quality prior to land application must be as follows:

BOD_5	25 mg/l
SS	30 mg/l
Fecal Coliform	200 MPN/100 ml

A storage lagoon with a minimum 210-day capacity must be built in accordance with criteria for waste stabilization ponds.

Land application systems must be located 1 mile from municipal water supplies, and .25 mile from a private water supply, human residence, state park or other recreation area, and crop irrigation area.

Minnesota requires a storage lagoon with a 210 capacity. This is a very large storage requirement, and may affect the decision to choose the land application alternative.

Buffer zones should be developed by purchase of adjacent land, or control of land use in adjacent area.

The site should be diked to 1) prevent runoff from leaving the site, 2) aid in recapture of effluent, and 3) prevent extra surface water from entering the site.

Overall application should not exceed 52"/acre-yr. This figure is used in calculating required acreage. Maximum application rate is set at 2"/acre-wk except for July and August, when up to 4"/acre-wk may be allowed. Maximum application rate is 0.5"/hr, with a maximum total application of 0.25"/hr. The spray season is limited to 18 weeks. No part of the field may be sprayed continuously for more than six days.

Spray equipment should minimize wind drift and aerosol formation. There should be provision for automatic shutoff of irrigation during precipitation.

Slopes of 2% are recommended for broad field or ridge-and-furrow systems. The latter systems should utilize trenches 1' deep, and 8" apart.

The site should be fenced to prevent entrance by livestock, wild animals, or humans. Warning signs should be posted. Monitoring wells are required 200' beyond the site perimeter, 500' apart, and should extend no deeper than 5' below the seasonal low water table. Separate wells are to be used to sample water from deeper strata. The quality and quantity of effluent discharged to the field, and the static water level of the wells, should also be measured. Routine tests required include:

Conductivity
Chlorides
Dissolved Salts
Nitrates
Nitrites
Ammonia
Methylene blue active substance
Fecal Coliform
BOD_5
Phosphorus

Acceptable vegetative cover is required. It should be harvested and disposed of at least once a year.

Additional treatment and/or site abandonment may be required if there is a significant change in groundwater quality or effluent quality from the spray field.

Site abandonment may be required if there is significant change in the groundwater quality or effluent quality from the spray field.

The wastewater applied to land should conform as much as possible to drinking water standards.

Table 12. Summary of design criteria for land application of wastes in Minnesota

Parameter	Guideline
Pretreatment	BOD_5 25 mg/l Suspended solids 30 mg/l fecal coliform 200 MPN/100 ml
Runoff Control	Dikes to prevent runoff
Hardware	Automatic shutoff capability during precipitation
Buffer Zone	To extent possible through purchase or control of adjacent land
Monitoring	One well in each direction of major underground flow. Wells 200' beyond perimeter, 500' apart, no deeper than 5' below low water table. Baseline data before operation; test for conductivity, chlorine residual, total dissolved solids, Nitrate-, nitrite-, and ammonia -nitrogen, phosphorus, fecal coliform, methylene blue active substance
Cover Crop	Harvest once per year
Storage	210 days
Spray Season	18 weeks
Application Rate	2 in./week
Groundwater	At least 10' to groundwater; at least 4' if underdrained

Conclusions

The states of the nation, empowered by Congress to regulate waste management activities within their boundaries, have taken varying approaches to the land application alternative. As of 1977, 37 of 50 states had issued regulations or guidelines for this practice. Two states were preparing guidelines. Of the remaining 11 states, most approve design plans on a case-by-case basis. Existing pollution control legislation of the state, as well as existing guidelines for land application developed by other states or agencies are frequently used for reference.

Regulations and guidelines vary according to geography, demography, and economy of the states. The states which have issued guidelines are primarily those which have larger populations and are more industrialized. The popularity of land application in the state has also affected the promptness with which guidelines have been issued in the past. Since land application must be considered in order to receive federal funding under the provisions of Section 201 of PL 92-500, it is anticipated that all states will have guidelines within a few years.

Several regulations may severely affect the viability of land application as an alternative. The cost of land is a major portion of the system cost, and requirements for storage and buffer zones may impinge on the cost-effectiveness of the system. For example, using Minnesota's requirement for a 210 day storage capacity, and assuming a 1 MGD flow, an additional 92 acres would be required for a storage lagoon 7 feet deep. Using Pennsylvania's requirement for a 200' buffer zone all around the irrigation area, a spray field 1 mile square would require nearly 100 additional acres for the buffer zone.

Several guidelines issued by the states may prove severely restrictive to land application as a cost-effective alternative. The requirements for secondary pretreatment, extensive storage, and buffer zones make these systems much less competitive in cost.

The requirement that the wastewater receive secondary treatment prior to land application also severely restricts the viability of land application as a practicable treatment technology. Most of the states require secondary treatment or its equivalent prior to land application. For a 1 MGD flow, secondary treatment involves about a $50,000 annual operating cost. This additional cost could eliminate land application from the ranks of cost-effective alternatives.

The secondary treatment requirement regulates the BOD_5, suspended solids, and fecal coliform allowed in wastewater used for irrigation. However, other waste constituents which may cause problems, particularly nitrate, phosphorus, and toxic substances, are not regulated by the majority of states.

Land application can be a viable, cost-effective waste treatment alternative at appropriate sites. It should be remembered that land application systems are specific to each site, and it is often difficult to generate guidelines which are applicable to all systems. In developing guidelines, states should allow sufficient latitude in order to take full advantage of the potential of land application.

Attention must be paid to loading rates for nitrate, phosphorous, and toxic substances, as well as BOD_5, suspended solids, and fecal coliform concentrations. Most states do not have guidelines for these waste constituents, which, if applied in excess, could cause system problems.

Requirements for secondary treatment should depend on the ability of the site to remove waste constituents, and the management scheme to be used at the site. Loading rates should take into account nitrogen, phosphorus, and toxic substances, as well as BOD_5, suspended solids and the concentration of fecal coliforms. In most instances, land application system designs are approved or denied on the basis of careful, site specific evaluations. As long as this continues to be the case, land application can remain a viable waste management alternative.

Water Doctrines in U.S. Either Riparian or Appropriative

The major water doctrines in the United States -- riparian or appropriative--qualify surface water rights apart from other types of real property. The

The major U.S. water doctrines make the use of water, not the water itself, the subject of the property involved.

difference lies in the fact that the use of the water, not the water itself, is the subject of the property right involved. The riparian doctrine recognizes a property right to the water only when the use of it is reasonable in terms of allowing others who share ownership of stream bank property to have an equal right to the water. Under the appropriative doctrine, a property right does not even arise until the water has been put to beneficial use. There is general agreement that beneficial use and reasonable use both carry economic as well as legal connotations (Wallace and Cox, 1973).

Land Application Constitues An Additional Use

Application of municipal sludges and effluents to land constitutes an additional water use. Although this recycling has most of the attributes of irrigation, the rate of application and other parameters are defined not in terms of optimum irrigation but obtaining improved water quality. Therefore, the question must be asked: Is this recycling of wastewater a beneficial or reasonable use under current water law doctrines? While improved water quality may well be accepted as a national goal, should it be obtained at the expense of property rights established by state water laws?

Land application constitutes a use of water in addition to "normal" consumptive uses.

Appropriative Rights Are Not Tied to Land Ownership

Appropriative rights tended to be enacted by statute and defined in the courts on a case-by-case basis. As a result, wide variations exist among the 19 western states that recognize such rights. In general, the basic principles of appropriative rights theory are: (1) first in time, first in right for the water, and (2) subsequent appropriations cannot diminish the quantity or quality of a senior right. Usually, permits are required to establish the right to appropriative water, and the water thus appropriated must also be put to a beneficial use.

Appropriative water rights are based on first in time, first in right of water, and on the belief that subsequent appropriations of water cannot diminish the quantity or quality of a senior water right.

Rights to appropriated water are not connected with land ownership. They may be bought, sold, exhanged, or transferred wholly or in part (Powell, 1975).

The general rule in those western, mostly arid states following the appropriative doctrine, is that once established, water use will remain substantially unchanged unless change can be accomplished without detriment to other appropriators--including those with junior rights. Thus a conflict arises where a proposed modification in use involves a change from nonconsumptive to a consumptive use, since the latter depletes the source of flow by not returning the water to its original channel. This is the case when a large percentage of the stream flow is effluent discharge.

Generally, it is the western mostly arid states which follow the appropriative water rights doctrine.

Land application of municipal wastewater would appear to fall into this category of change. Irrigation is a greater consumer of water than traditional municipal use. In fact, the appropriator located immediately downstream from the previous point of waste discharge may be denied all use of the return flow that existed before irrigation was started.

Land application of wastewater may involve a change from nonconsumptive to a consumptive use, depleting the source of flow by not returning the water to its original channel.

Many states recognize a combination of riparian and appropriative rights. This dual-rights system has developed in states that have water-short and water-surplus areas within their borders. In such cases, the appropriative theory is usually the predominant one (Large, no date).

Knowledge of Water Rights Law Is Needed

On the basis of water rights, the operation of a land treatment system may involve a change in water use from nonconsumptive (passing flow through a plant for treatment and subsequently discharging it to the same stream used for water supply) to consumptive. This change can interfere with the water rights of downstream or senior claims to the water because the source of flow is depleted when the discharge is not returned to its original channel. Because this potential for legal problems exists, a knowledge of water rights law is both desirable and necessary. Water rights problems tend to arise in areas where water is in short supply or where it has been fully allocated. Yet the existence of a market for reclaimed water in these areas will aid in the cost effectiveness and acceptability of land treatment. On a national level, these areas are shown in Figure 11.

Water rights problems tend to arise in areas where water is in short supply or where it is fully allocated.

Most riparian or land ownership rights are in effect east of the Mississippi River and most appropriative or permit system rights are in effect west of the Mississippi. A legal distinction is made between discharges to a receiving water in a well-defined channel or basin (natural watercourse), superficial waters not in a channel or basin (surface waters), and underground waters not in a well-defined channel or basin (percolating or groundwaters). Table 13 is a guide to determine whether certain land treatment alternatives will present water rights problems.

Most States Operate Under Riparian Rights

Most states operate under the riparian doctrine. This is based on the simple premise that whoever owns land traversed by or bordering a flowing stream may make reasonable uses of its waters that do not interfere with other property owners having similar rights. After making a reasonable use of the water for his own purposes, a riparian owner must return all the surplus to its natural channel before it reaches downstream riparian owners.

Most states follow riparian doctrine, requiring landowners adjacent to streams to return all surplus water to its natural channel after making a reasonable use of the water.

The amount of acreage required for land disposal makes it unlikely that land so used would be situated so that return flows would reach the stream of origin at a point above the property lines of all lower riparians. Therefore, land application is likely to

FIGURE 11. (Metcalf and Eddy, 1977, from Large)

DOMINANT WATER RIGHTS DOCTRINES AND AREAS OF WATER SURPLUS OR DEFICIENCY

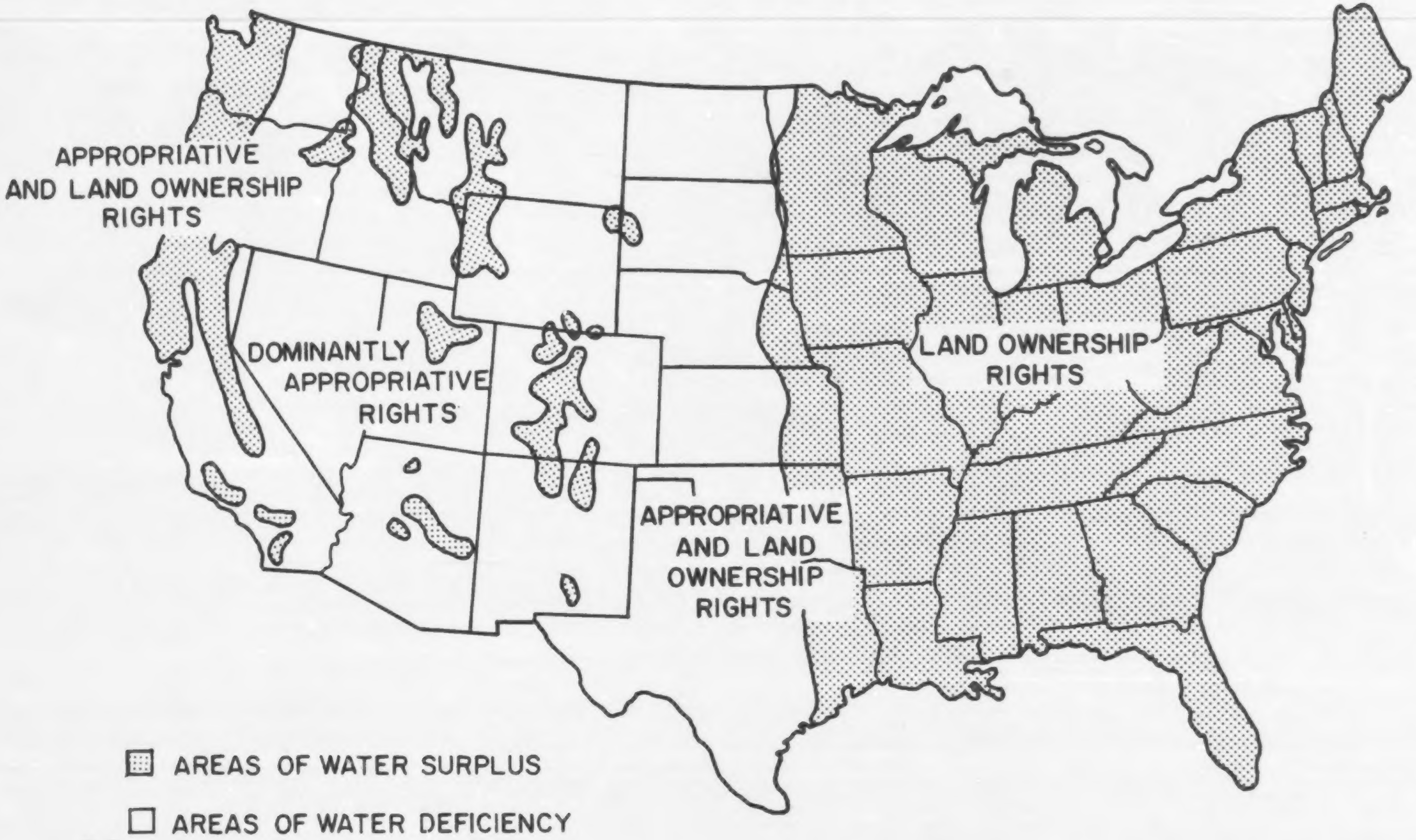
APPROPRIATIVE AND LAND OWNERSHIP RIGHTS
DOMINANTLY APPROPRIATIVE RIGHTS
LAND OWNERSHIP RIGHTS
APPROPRIATIVE AND LAND OWNERSHIP RIGHTS
▨ AREAS OF WATER SURPLUS
☐ AREAS OF WATER DEFICIENCY

TABLE 13
(after Metcalf and Eddy, 1977)

POTENTIAL WATER RIGHTS PROBLEMS FOR LAND TREATMENT ALTERNATIVES[a]

Water definition and water rights theory	Land treatment process		
	Slow rate	Rapid infiltration	Overland flow
Natural watercourses			
Riparian	Unlikely	Unlikely	Unlikely
Appropriative	Likely[b]	Likely[b]	Depends on location of discharge from collection ditch
Combination	Likely[b]	Likely[b]	Depends on location of discharge from collection ditch
Surface waters			
Riparian	Unlikely	Unlikely	Likely[c]
Appropriative	Unlikely	Unlikely	Likely[c]
Combination	Unlikely	Unlikely	Likely[c]
Percolating or groundwaters			
Riparian	Unlikely	Possible	Unlikely
Appropriative	Likely	Likely	Unlikely
Combination	Likely	Likely	Unlikely

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a. For existing conditions and alternatives formulation stage of the planning process only. It is also assumed that the appropriative situations are water-short or over-appropriated.

b. If effluent was formerly discharged to stream.

c. If collection/discharge ditch crosses other properties to natural watercourse.

violate the rights of other water users on the stream.

The situation is complicated further when the return flows ultimately find their way to a different stream. Such interbasin transfers generally are not recognized under the riparian doctrine. There is no cause for legal action if no actual injury has occurred to another landowner's rights. Therefore, legal obstacles may not exist where there is water surplus. Where a surplus does not exist, land application could be excluded in some riparian situations unless special provisions are made to either acquire the water rights of those affected or to return the used effluent to a point above the lower riparian properties.

Land application is likely to violate the rights of other water users of the stream only if there is no surplus, and legal obstacles may arise in areas where water is in short supply.

Since the riparian doctrine protects the quantity and the quality of the flow on behalf of abutting landowners, it automatically protects the natural watercourse itself. Included in this protection are the stream's scenic attributes, associated wildlife habitats, and instream uses, such as fishing and recreation. Where the recycling of waste effluents significantly modifies the stream regimen, these other attributes may become the basis of a legal action by any affected citizen.

Surface water problems must be carefully considered when designing land disposal systems in light of today's more liberal court interpretations on such questions as the right to sue and class actions on behalf of groups possessing a common interest. Opening the courtroom doors to such actions greatly expands the liability potential.

More liberal court interpretations on the right to sue and class action suits increase the liability of land application operators for violation of water rights.

Natural Watercourses Flow in Defined Channels

A natural watercourse is one in which water flows in a defined channel either on or below the earth's surface. It includes lakes, estuaries, and intermittent and perennial streams. The major legal problem with natural watercourses in both riparian and appropriative states is the reduced discharge which may result from diversion of what was a direct discharge through a land application site to the watercourse. If the watercourse is near or at overappropriation, junior water users who feel that a reduction in flow may impair their reasonable use of the water may seek administrative or judicial relief. In a riparian state, the diversion of a discharge that was not originally part of a stream should not be cause for legal action by downstream users under natural flow theory.

The major problem with natural watercourses is the diversion of what was a direct discharge through a land application site to the natural watercourse.

For appropriative rights states, the risk of legal action against the diversion is easier to analyze. If the conditions of the stream are such that the diversion would threaten the quality or quantity of the appropriated water of a downstream user, the damaged party has cause for legal action against the diverter. This action may be injunctive, in which the diverter is prevented from affecting the diversion, or monetary, in which the diverter would be required to compensate for damages caused by his diversion. If the stream in dispute is not already over-appropriated as is the case in many western streams, or if the area is not short of water, it is unlikely that damages could be proved as a result of the diversion.

If the diversion threatens the quality or quantity of the appropriated water of a downstream user, the damaged party can sue the diverter. This is more likely to happen in areas short of water.

Surface Waters Are Not Contained in Basins or Channels

Surface waters are not contained in a well-defined basin or channel. Examples are rainfall or snowmelt directly on a parcel of land. Such waters belong to the landowner, but he cannot collect or discharge them across adjoining properties without the consent of the owners of those lands. This is true in both riparian and appropriative states.

If any of the land treatment alternatives under consideration require that the renovated water cross another's property, the granting of a drainage or utility easement across the land to the natural watercourse or final user is necessary in all cases. The cost of such an easement must be considered in the cost-effectiveness analysis.

If land treatment requires that the renovated water cross another's property, the granting of a drainage or utility easement across the land to the natural watercourse or final user is necessary.

Some Cases Uphold Right to Pure Groundwater

Land application of wastewater may be legally constrained by private rights to groundwater in cases where alteration of water quality or natural flow patterns result in adverse effects. Although land treatment is intended to reduce overall water pollution, any degradation of groundwater quality may subject the operator to legal action by the users of that water. Groundwater discharge may also damage other users by artificially raising their water table.

Any artificial rise in the water table or any degradation of groundwater quality by the land treatment site operator may be grounds for a suit.

In riparian states, the claim of damages would require that a landowner prove that he overlies the same source of groundwater as the land treatment operator. If the alleged damages are not caused by negligent operation of the land treatment site, or operation that is deliberately harmful to the adjoining land owners, it would be doubtful that there would be sufficient cause for legal action. In appropriative states, the question of an increase in the level or volume of a groundwater should cause no problems because no one's appropriative right would be threatened.

The right of the landowner to uncontaminated groundwater has not always been recognized. In some cases the courts have been reluctant to impose liability where the pollution resulted from lawful uses of adjoining land. The justification for this attitude has been that such property injury could not have been anticipated. In other cases, however, the right to uncontaminated water has been upheld and those responsible for contamination have been held liable. In these cases, the right to pure groundwater has been viewed as absolute. Liability has been imposed on the party responsible for degradation of the water without regard to the reasonableness of the activity or the care with which the operation was conducted.

The courts have wavered in establishing the right to uncontaminated groundwater and have been reluctant to impose liability where the pollution resulted from lawful uses of adjoining land. In other cases, the right to pure groundwater has been viewed as absolute.

Other Water Rights to Consider

In some states, basin authorities or water irrigation districts have regulations against the transfer of water outside their jurisdictional boundaries. In the western states particularly, the right to divert or use water does not carry with it the right to store such water. The right to water salvaged from imported water that has run off irrigated lands is not automatic either. The rights in both cases must be specifically obtained or at least must be assured by precedent legal action.

A brief overview of water rights law may be sufficient for the operation of small land treatment systems, but for larger systems and in problem areas the watermaster or water rights engineer at the state or local level should be consulted. Some states either have no records or carry unenforceable rights in their records, so that further investigation will be necessary if doubt remains.

The watermaster or a water rights engineer at the state or local level should be consulted when designing large land treatment sites or in problem areas.

An excellent reference, A Summary-Digest of State Water Laws by R. L. Dewsnup and D. W. Jensen, is available from the National Water Commission in Washington, D.C. Although summaries of precedent rulings are not guarantees, they may clarify the situation if similar cases can be found. Finally, if problems arise, a water rights attorney should be consulted.

If legal problems arise over water, a water rights attorney should be consulted.

Water Rights Problems Can Be Resolved

To resolve water rights problems, the project engineer should do the following:

- --try to define the water rights setting that could affect the fate of any renovated water
- --be aware of the quantity and priority of all water rights in the district or basin
- --define the water rights constraints for all alternatives
- --once the candidate systems have been selected, examine the point of discharge, availability and quantity of discharge, and modifications to existing practices
- --if there are problems with any of the feasible alternatives, consult a water rights attorney to define more closely the legal constraints on the alternatives and to define the land treatment operator's rights and responsibilities.

If the land treatment operator's rights to the renovated water can be established, he can now trade those rights with any potentially damaged senior rights or use the revenues from sale of the water to offset possible damage claims. (Metcalf and Eddy, 1977).

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Appendix A

Recommendations of the National Commission on Water Quality

1) Maintaining the July 1, 1977, compliance date with "uniform treatment requirements by both industry and publicly owned treatment works, but provide some flexibility to grant extensions, and even waivers, on a case-by-case and category-by-category basis;" 2) maintaining the 1983 interim water quality goal, but "postponing the 1983 requirements for application of uniform technologies five to ten years, pending an assessment of progress in water quality improvement and review of these results by a new National Commission on Water Quality by 1985;" 3) meeting the 1983 Interim water quality goal by "application of the 1977 requirements to all dischargers, revisions of 1977 limitations, effluent limitations for the elimination of the discharge of toxic pollutants in toxic amounts beginning immediately, new source performance standards for all new point source discharges, periodic upgrading of permits for discharges into water quality limited waters, and application of control measures to combined sewer overflows, stormwater runoff, agricultural and nonpoint sources;" 4) the decentralization of regulatory and administrative "functions of the national program by selective certification of states, based on satisfactory state plans and programs to control both point and nonpoint sources (including irrigated agriculture);" 5) stabilization of the Federal construction grants program "by assuring 75 percent Federal financing for priority treatment made at a fixed amount (not less than $5 billion nor more than $10 billion per year) for a specified number of years (five to ten);" 6) redefining the "goal of elimination of discharge of pollutants with one stressing conservation and reuse of resources;" 7) authorizing flexibility in applying control or treatment measures to irrigated agriculture after an inventory of the problem, and support salinity alleviation projects to reduce salt loads from sources other than man's activities.

Appendix B

Text of pertinent sections of PL 92-500 discussed in Part II

Section 102(a) - Comprehensive programs for water pollution control:

(a) The Administrator shall, after careful investigation, and in cooperation with other Federal agencies, State water pollution control agencies, interstate agencies, and the municipalities and industries involved, prepare or develop comprehensive programs for preventing, reducing, or eliminating the pollution of the navigable waters and groundwaters and improving the sanitary condition of surface and underground waters. In the development of such comprehensive programs due regard shall be given to the improvements which are necessary to conserve such waters for the protection and propagation of fish and aquatic life and wildlife, recreational purposes, and the withdrawal of such waters for public water supply, agricultural, industrial, and other purposes. For the purpose of this section, the Administrator is authorized to make joint investigations with any such agencies of the conditions of any waters in any State or States, and of the discharges of any sewage, industrial wastes, or substance which may adversely affect such waters.

Sec. 201(f) - "(f) The Administrator shall encourage waste treatment management which combines 'open space' and recreational consideration with such management.

Section 201 (b) - Best practicable waste treatment technology:

"(b) Waste treatment management plans and practices shall provide for the application of the best practicable waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water, and confined disposal of pollutants so they will not migrate to cause water or other environmental pollution and shall provide for consideration of advanced waste treatment techniques.

Section 201 (d) - Recycling of Pollutants:

"(d) The Administrator shall encourage waste treatment management which results in the construction of revenue providing facilities providing for--

"(1) the recycling of potential sewage pollutants through the production of agriculture, silviculture, or aquaculture products, or any combination thereof;

"(B) as appropriate, the works proposed for grant assistance will take into account and allow to the extent practicable the application of technology at a later date which will provide for the reclaiming or recycling of water or otherwise eliminate the discharge of pollutants.

Section 201 (e) - Cost-effectiveness:

"(e) The Administrator shall encourage waste treatment management which results in integrating facilities for sewage treatment and recycling with facilities to treat, dispose of, or utilize other industrial and municipal wastes, including but not limited to solid waste and waste heat and thermal discharges. Such integrated facilities shall be designed and operated to produce revenues in excess of capital and operation and maintenance costs and such revenues shall be used by the designated regional management agency to aid in financing other environmental improvement programs.

Section 201 (g) (1) - Financing:

"(g)(1) The Administrator is authorized to make grants to any State, municipality, or intermunicipal or interstate agency for the construction of publicly owned treatment works.

Section 201 (g)(2)(A) - Alternative Techniques:

"(2) The Administrator shall not make grants from funds authorized for any fiscal year beginning after June 30, 1974, to any State, municipality, or intermunicipal or interstate agency for the erection, building, acquisition, alteration, remodeling, improvement, or extension of treatment works unless the grant applicant has satisfactorily demonstrated to the Administrator that--

"(A) alternative waste management techniques have been studied and evaluated and the works proposed for grant assistance will provide for the application of the best practicable waste treatment technology over the life of the works consistent with the purposes of this title;

"(2) The Administrator, after consultation with appropriate Federal and State agencies and other interested persons, shall publish within nine months after the date of enactment of this title (and from time to time thereafter) information on alternative waste treatment management techniques and systems available to implement section 201 of this Act.

Section 212 - Definitions:

"Sec. 212. As used in this title--

"(1) The term 'construction' means any one or more of the following: preliminary planning to determine the feasibility of treatment works, engineering, architectural, legal, fiscal, or economic investigations or studies, surveys, designs, plans, working drawings, specifications, procedures, or other necessary actions, erection, building, acquisition, alternation, remodeling, improvement, or extension of treatment works or the inspection or supervision of any of the foregoing items.

"(2)(A) The terms 'treatment works' means any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature to implement section 201 of this Act, or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment, and their appurtenances; extensions, improvements, remodeling, additions, and alterations thereof; elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities; and any works, including site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal of residues resulting from such treatment.

"(B) In addition to the definition contained in subparagraph (A) of this paragraph, 'treatment works' means any other method or system for preventing, abating, reducing, storing, treating, separating, or disposing of municipal waste, including storm water runoff, or industrial waste, including waste in combined storm water and sanitary sewer systems. Any application for construction grants which includes wholly or in part such methods or systems shall, in accordance with guidelines published by the Administrator pursuant to sub-paragraph (C) of this paragraph, contain adequate data and analysis demonstrating such proposal to be, over the life of such works, the most cost efficient alternative to comply with sections 301 or 302 of this Act, or the requirements of section 201 of this Act.

Section 301 - Effluent Limitations:

"Sec. 301. (a) Except as in compliance with this section and sections 302, 306, 307, 318, 402, and 404 of this Act, the discharge of any pollutant by any person shall be unlawful.

"(b) In order to carry out the objective of this Act there shall be achieved--

"(1)(A) not later than July 1, 1977, effluent limitations for point sources, other than publicly owned treatment works, (i) which shall require the application of the best practicable control technology currently available as defined by the Administrator pursuant to section 304(b) of this Act, or (ii) in the case of a discharge into a publicly owned treatment works which meets the requirements of sub-paragraph (B) of this paragraph, which shall require compliance with any applicable pretreatment requirements and any requirements under section 307 of this Act; and

"(B) for publicly owned treatment works in existence on July 1, 1977, or approved pursuant to section 203 of this Act prior to June 30, 1974 (for which construction must be completed within four years of approval), effluent limitations based upon secondary treatment as defined by the Administrator pursuant to section 304(d)(1) of this Act; or,

"(C) not later than July 1, 1977, any more stringent limitation, including those necessary to meet water quality standards, treatment standards, or schedules of compliance, established pursuant to any State law or regulation (under authority preserved by section 510) or any other Federal law or regulation, or required to implement any applicable water quality standard established pursuant to this Act.

"(2)(A) not later than July 1, 1983, effluent limitations for categories and classes of point sources, other than publicly owned treatment works, which (i) shall require application of the best available technology economically achievable for such category or class, which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants, as determined in accordance with regulations issued by the Administrator pursuant to section 304(b)(2) of this Act, which such effluent limitations shall require the elimination of discharges of all pollutants if the Administrator finds, on the basis of information available to him (including information developed pursuant to section 315), that such elimination is technologically and economically achievable for a category or class of point sources as determined in accordance with regulations issued by the Administrator pursuant to section 304(b)(2) of this Act, or (ii) in the case of the introduction of a pollutant into a publicly owned treatment works which meets the requirements of subparagraph (B) of this paragraph, shall require compliance with any applicable pretreatment requirements and any other requirement under section 307 of this Act; and

"(B) not later than July 1, 1983, compliance by all publicly owned treatment works with the requirements set forth in section 201(g)(2)(A) of this Act.

"(c) The Administrator may modify the requirements of subsection (b)(2)(A) of this section with respect to any point source for which a permit application is filed after July 1, 1977, upon a showing by the owner or operator of such point source satisfactory to the Administrator that such modified requirements (1) will represent the maximum use of technology within the economic capability of the owner or operator; and (2) will result in reasonable further progress toward the elimination of the discharge of pollutants.

"(d) Any effluent limitation required by paragraph (2) of subsection (b) of this section shall be reviewed at least every five years and if appropriate, revised pursuant to the procedure established under such paragraph.

"(c) Effluent limitations established pursuant to this section or section 302 of this Act shall be applied to all point sources of discharge of pollutants in accordance with the provisions of this Act.

"(c) The Administrator may modify the requirements of subsection (b)(2)(A) of this section with respect to any point source for which a permit application is filed after July 1, 1977, upon a showing by the owner or operator of such point source satisfactory to the Administrator that such modified requirements (1) will represent the maximum use of technology within the economic capability of the owner or operator; and (2) will result in reasonable further progress toward the elimination of the discharge of pollutants.

"(d) Any effluent limitation required by paragraph (2) of subsection (b) of this section shall be reviewed at least every five years and, if appropriate, revised pursuant to the procedure established under such paragraph.

"(e) Effluent limitations established pursuant to this section or section 302 of this Act shall be applied to all point sources of discharge of pollutants in accordance with the provisions of this Act.

"(f) Notwithstanding any other provisions of this Act it shall be unlawful to discharge any radiological, chemical, or biological warfare agent or high-level radioactive waste into the navigable waters.

Seciton 308 - Monitoring:

"Sec. 308. (a) Whenever required to carry out the objective of this Act, including but not limited to (1) developing or assisting in the development of any effluent limitation, or other limitation, prohibition, or effluent standard, pretreatment standard, or standard of performance; (2) determining whether any person is in violation of any such effluent limitation, or other limitation, prohibition or effluent standard, pretreatment standard or standard of performance; (3) any requirement established under this section; or (4) carrying out sections 305, 311, 402, and 504 of this Act--

"(A) The Administrator shall require the owner or operator of any point source to (i) establish and maintain such records, (ii) make such reports, (iii) install, use, and maintain such monitoring equipment or methods (including where appropriate, biological monitoring methods), (iv) sample such effluents (in accordance with such methods, at such locations, at such intervals, and in such manner as the Administrator shall prescribe), and (v) provide such other information as he may reasonably require; and

"(B) The Administrator or his authorized representative, upon presentation of his credentials--

"(i) shall have a right of entry to, upon, or through any premises in which an effluent source is located or in which any records required to be maintained under clause (A) of this subsection are located, and

"(ii) may at reasonable times have access to and copy any records, inspect any monitoring equipment or method required under clause (A), and sample any effluents which the owner or operator of such source is required to sample under such clause.

"(b) Any records, reports, or information obtained under this section (1) shall, in the case, of effluent data be related to any applicable effluent limitations, toxic, pretreatment, or new source performance standards, and (2) shall be available to the public, except that upon a showing satisfactory to the Administrator by any person that records, reports, or information, or particular part thereof (other than effluent data), to which the Administrator has access under this section, if made public would divulge methods or processes entitled to protection as trade secrets of such person, the Administrator shall consider such record, report, or information, or particular portion thereof confidential in accordance with the purposes of section 1905 of title 18 of the United States Code, except that such record, report, or information may be disclosed to other officers, employees, or authorized representatives of the United States concerned with carrying out this Act or when relevant in any proceeding under this Act.

"(c) Each State may develop and submit to the Administrator procedures under State law for inspection, monitoring, and entry with respect to point sources located in such State. If the Administrator finds that the procedures and the law of any State relating to inspection, monitoring, and entry are applicable to at least the same extent as those required by this section, such State is authorized to apply and enforce its procedures for inspection, monitoring and entry with respect to point sources located in such State (except with respect to point sources owned or operated by the United States).

Section 405 - Disposal of sewage sludge:

"Sec. 405. (a) Notwithstanding any other provision of this Act or of any other law, in any case where the disposal of sewage sludge resulting from the operation of a treatment works as defined in section 212, of this Act (including the removal of in-place sewage sludge from one location and its deposit at another location) would result in any pollutant from such sewage sludge entering the navigable waters, such disposal is prohibited except in accordance with a permit issued by the Administrator under this section.

"(b) The Administrator shall issue regulations governing the issuance of permits for the disposal of sewage sludge subject to this section. Such regulations shall require the application to such disposal of each criterion, factor, procedure, and requirement applicable to a permit issued under section 402 of this title, as the Administrator determines necessary to carry out the objective of this Act.

"(c) Each State desiring to administer its own permit program for disposal of sewage sludge within its jurisdiction may do so if upon submission of such program the Administrator determines such program is adequate to carry out the objective of this Act."

Appendix C

Text of memo from John Quarles

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

SUBJECT: Land Treatment DATE: November 1, 1974

FROM: Deputy Administrator /s/ John Quarles

TO: Regional Administrators

The purpose of this memorandum is to express my concern that EPA must do a better job in assuming that land treatment is given full and adequate consideration as a possible method for municipal sewage disposal in projects funded with Federal grants.

Land application of wastewaters is practiced successfully and extensively in the United States. Many land treatment systems have been in continuous use since 1900. It is apparent from this long-term experience and documented research work that land treatment technology is a viable alternative to be considered as part of waste management systems.

In section 201 of the Federal Water Pollution Control Act Amendments of 1972, it declares that:

> "Waste treatment management plans and practices shall provide for the application of the best practicable waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water, and confined disposal of pollutants so they will not migrate to cause water or other environmental pollution and shall provide for consideration of advance waste treatment techniques."

Pursuant to section 304(d)(2), which directs EPA to publish information on alternative treatment management techniques and systems available to implement section 201, the document "Alternative Waste Management Techniques for Best Practicable Waste Treatment" was published. Therein it considers land application as a viable alternative for best practicable waste treatment.

In addition, the Cost-Effectiveness Analysis Regulations which apply to all projects subject to best practicable treatment state that:

> "All feasible alternative waste management systems shall be initially identified. These alternatives should include systems discharging to receiving waters, systems using land or surface disposal techniques, and systems employing the reuse of wastewater."

The above requirements shall be met for all projects awarded after June 30, 1974. This means that land treatment must be considered in the basic selection of method for waste treatment.

I urge that you ascertain that your regional review of application for construction of publicly-owned treatment works require that land application be considered as an alternative waste management system. If it can be demonstrated that land treatment is the most cost-effective alternative, is consistent with the environmental assessment, and in order aspects satisfies applicable tests, the Region should insist that land treatment be used and should refuse to fund projects using other systems of waste treatment.

Your director of Water Programs Division has received the draft document "Evaluation of Land Application Systems." This document should be utilized during the review process. Additional assistance can be obtained by contacting the Municipal Construction Division (OWPO), the Municipal Technology Division (ORD), or the Robert S. Kerr Laboratory (RD).

In order to promulgate proper consideration of land treatment systems by future grant applicants I suggest that the Regional Office provide opportunity for public awareness of land treatment technology. As an example, Region III is planning a two day symposium November 20 - 31, 1974, at the University of Delaware to highlight land application technology. The idea for the symposium originated in the Regional Office and was planned cooperatively between the regional staff and Office of Water Program Operations headquarters staff. The objective of the symposium is to clarify the technical and policy issues involved and to chart directions for future decisions on land treatment techniques. The symposium will provide useful information to over 300 engineers, scientists, public officials and private citizens. This technique or a similar one could be used by your region to emphasize consideration of land treatment.

Appendix D

National Interim Primary Drinking Water Regulations for Groundwater

Case 1: The groundwater can potentially be used for drinking water supply.

(1) The maximum contaminant levels for inorganic chemicals and organic chemicals specified in the National Interim Primary Drinking Water Regulations (40 CFR 141) (Appendix D) for drinking water supply systems should not be exceeded except as indicated below (see Note 1).

(2) If the existing concentration of a parameter exceeds the maximum contaminant levels for inorganic chemicals or organic chemicals, there should not be an increase in the concentration of that parameter due to land application of wastewater.

Case II: The groundwater is used for drinking water supply.

(1) The criteria for Case I should be met.

(2) The maximum microbiological contaminant levels for drinking water supply systems specified in the National Interim Primary Drinking Water Regulations (40 CFR 141) (Appendix D) should not be exceeded in cases where the groundwater is used without disinfection (see Note 1).

Case III: Uses other than drinking water supply.

(1) Groundwater criteria should be established by the Regional Administrator based on the present or potential use of the groundwater.

The Regional Administrator in conjunction with the appropriate State officials and the grantee shall determine on a site-by-site basis the areas in the vicinity of a specific land application site where the criteria in Case I, II, and III shall apply. Specifically determined shall be the monitoring requirements appropriate for the project site. This determination shall be made with the objective of protecting the groundwater for use as a drinking water supply and/or other designated uses as appropriate and preventing irrevocable damage to groundwater. Requirements shall include provisions for monitoring the effect on the native groundwater.

(C) Alternatives Employing Reuse. The total quantity of any pollutant in the effluent from a reuse project which is directly attributable to the effluent from a publicly-owned treatment works shall not exceed that which would have been allowed under Paragraphs (A) and (B) above.

Note 1.-- Any amendments of the National Interim Primary Drinking Water Regulations and National Revised Primary Drinking Water Regulations hereafter issued by EPA prescribing standards for public water system relating to inorganic chemicals, organic chemicals or microbiological contamination shall automatically apply in the same manner as the National Interim Primary Drinking Water Regulations.

Groundwater Requirements:

The following maximum contaminant levels contained in the National Interim Primary Drinking Water Regulations (40 CFR 141) are reprinted for convenience and clarity. The National Interim Primary Drinking Water Regulations were published in final form in the Federal Register on December 24, 1975. In accordance with the criteria for best practicable waste treatment, 40 CFR 141 should be consulted in its entirety when applying the standards contained therein to wastewater treatment systems employing land application techniques and land utilization practices.

Maximum Contaminant levels for inorganic chemicals. The following are the maximum levels of inorganic chemicals other than fluoride:

Contaminant:	Level (milligrams per liter)
Arsenic	0.05
Barium	1.
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as N)	10.
Selenium	0.01
Silver	0.05

The maximum contaminant levels for fluoride are:

Temperature degrees Fahrenheit[1]	Degrees Celsius	Level (milligrams per liter)
53.7 and below	12 and below	2.4
53.8 to 58.3	12.1 to 14.6	2.2
58.4 to 63.8	14.7 to 17.6	2.0
63.9 to 70.6	17.7 to 21.4	1.8
70.7 to 79.2	21.5 to 26.2	1.6
79.3 to 90.5	26.3 to 32.5	1.4

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[1] Annual average of the maximum daily air temperature.

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Maximum contaminant levels for organic chemicals. The following are the maximum contaminant levels for organic chemicals:

	Level (milligram per liter)
(a) Chlorinated hydrocarbons:	
Endrin (1, 2, 3, 4, 10, 10-Hexachloro 6, 7 - epoxy - 1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4,-endo, endo - 5, 8-dimethano naphthalene)	0.0002
Lindane (1, 2, 3, 4, 5, 6 - Hexachlorocyclohexane, gamma isomer)	0.004
Methoxychlor (1, 1, 1 - Trichloro -2, 2-bis [p-methoxyphenyl] ethane	0.1
Toxaphene ($C_{10}H_{10}Cl_8$ - Technical chlorinated Technical chlorinated camphene, 67 to 69 percent chlorine	0.005
(b) Chlorophenoxys:	
2, 4-D (2, 4-Dichlorophenoxyacetic acid	0.1
2,4,5-TP Silve (2, 4, 5-Trichlorophenoxypropionic acid)	0.01

Maximum microbiological contaminant levels. The maximum contaminant levels for coliform bacteria, applicable to community water systems and non-community water systems are as follows:

(a) When the membrane filter technique pursuant to 141.21(a) is used, the number of coliform bacteria shall not exceed any of the following:

(1) One per 100 milliliters as the arithmetic mean of all samples examined per month pursuant to 141.21(b) or (c):

(2) Four per 100 milliliters in more than one sample when less than 20 are examined per month; or

(3) Four per 100 milliliters to more than five percent of the samples when 20 or more are examined per month.

(b)(1) When the fermentation tube method and 10 milliliter standard portions pursuant to 141.21(a) are used, coliform bacteria shall not be present in any of the following:

(i) More than 10 percent of the portions in any month pursuant to 141.21 (b) or (c):

(ii) Three or more portions in more than one sample when less than 20 samples are examined per month; or

(iii) Three or more portions in more than five percent of the samples when 20 or more samples are examined per month.

(2) When the fermentation tube method and 100 milliliter standard portions pursuant to 141.21(a) are used coliform bacteria shall not be present in any of the following:

(i) More than 60 percent of the portions in any month pursuant to 141.21(b) or (c):

(ii) Five portions in more than one sample when less than five samples are examined per month; or

(iii) Five portions in more than 20 percent of the samples when five or more samples are examined per month.

(c) For community or non-community systems that are required to sample at a rate of less than 4 per month, compliance with Paragraphs (a), (b)(1), or (2) shall be based upon sampling during a 3 month period, except that, at the discretion of the State compliance may be based upon sampling during a one month period.

Source: Federal Register 41(29): 6190-6191

Appendix E

The National Environmental Policy Act of 1969

Introduction and Title 1

An act to establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that this Act may be cited as the "National Environmental Policy Act of 1969."

PURPOSE

Sec. 2. The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

TITLE I

Declaration of National Environmental Policy

Sec. 101. (a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may--

(1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) Assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

(3) Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice:

(5) Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

Sec. 102. The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall--

(A) Utilize a systematic interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(B) Identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by Title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations;

(C) Include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on--

(i) The environmental impact of the proposed action,

(ii) Any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) Alternatives to the proposed action,

(iv) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. Prior to making any detailed statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statements and the comments and views of the appropriate Federal, State, and local agencies, which are authorized to develop and enforce environmental standards, shall be made available to the President, the Council on Environmental Quality and to the public as provided by section 552 of Title 5, United States Code, and shall accompany the proposal through the existing agency review processes;

(D) Study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources;

(E) Recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment;

(F) Make available to States, counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(G) Initiate and utilize ecological information in the planning and development of resource-oriented projects; and

(H) Assist the Council on Environmental Quality established by Title II of this Act.

Appendix F

Resource Conservation and Recovery Act of 1976

OBJECTIVES:

Sec. 1003. The objectives of this Act are to promote the protection of health and the environment and to conserve valuable material and energy resources by--

"(1) providing technical and financial assistance to State and local governments and interstate agencies for the development of solid waste management plans (including resource recovery and resource conservation systems) which will promote improved solid waste management techniques (including more effective organizational arrangements), new and improved methods of collection, separation, and recovery of solid waste, and the environmentally safe disposal of nonrecoverable residues;

"(2) providing training grants in occupations involving the design, operation, and maintenance of solid waste disposal systems;

"(3) prohibiting future open dumping on the land and requiring the conversion of existing open dumps to facilities which do not pose a danger to the environment or to health;

"(4) regulating the treatment, storage, transportation, and disposal of hazardous wastes which have adverse effects on health and the environment;

"(5) providing for the promulgation of guidelines for solid waste collection, transport, separation, recovery, and disposal practices and systems;

"(6) promoting a national research and development program for improved solid waste management and resource conservation techniques, more effective organizational arrangements, and new and improved methods of collection, separation, and recovery, and recycling of solid wastes and environmentally safe disposal of nonrecoverable residues;

"(7) promoting the demonstration, construction, and application of solid waste management, resource recovery, and resource conservation systems which perserve and enhance the quality of air, water, and land resources; and

"(8) establishing a cooperative effort among the Federal, State, and local governments and private enterprise in order to recover valuable materials and energy from solid waste.

DEFINITIONS:

Sec. 1004. As used in this Act:

"(3) The term 'disposal' means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters.

"(5) The term 'hazardous waste' means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may--

"(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

"(B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

"(26A) The term 'sludge' means any solid, semisolid or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility or any other such waste having similar characteristics and effects.

"(27) The term 'solid waste' means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

"(29)The term 'solid waste management facility' includes (A) any resource recovery system or component thereof, (B) any system, program, or facility for resource conservation, and (C) any facility for the treatment of solid wastes, including hazardous wastes, whether such facility is associated with facilities generating such wastes or otherwise.

IDENTIFICATION AND LISTING OF HAZARDOUS WASTE:

"Sec. 3001. (a) CRITERIA FOR IDENTIFICATION OR LISTING.--Not later than eighteen months after the date of the enactment of this Act, the Administrator shall, after notice and opportunity for public hearing and after consultation with appropriate Federal and State agencies, develop and promulgate criteria for identifying the characteristics of hazardous waste, and for listing hazardous waste, which should be subject to the provisions of this subtitle, taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous characteristics. Such criteria shall be revised from time to time as may be appropriate.

"(b) IDENTIFICATION AND LISTING.--Not later than eighteen months after the date of enactment of this section, and after notice and opportunity for public hearing, the Administrator shall promulgate regulations identifying the characteristics of hazardous waste, and listing particular hazardous wastes (within the meaning of section 1004(5)), which shall be subject to the provisions of this subtitle. Such regulations shall be based on the criteria promulgated under subsection (a) and shall be revised from time to time thereafter as may be appropriate.

RESEARCH, DEMONSTRATIONS, TRAINING, AND OTHER ACTIVITIES:

"Sec. 8001. (a) GENERAL AUTHORITY.--The Administrator, alone or after consultation with the Administrator of the Federal Energy Administration, the Administrator of the Energy Research and Development Administration, or the Chairman of the Federal Power Commission, shall conduct, and encourage, cooperate with, and render financial and other assistance to appropriate public (whether Federal State, interstate, or local) authorities, agencies, and institutions, private agencies and institution, and individuals in the conduct of,and promote the coordination of, research, investigations, experiments, training, demonstrations, surveys, public eudcation programs, and studies relating to--

"(1) any adverse health and welfare effects of the release into the environment of material present in solid waste, and methods to eliminate such effects;

"(2) the operation and financing of solid waste disposal programs;

"(10) improvements in land disposal practices for solid waste (including sludge) which may reduce the adverse environmental effects of such disposal and other aspects of solid waste disposal on land, including means for reducing the harmful environmental effects of earlier and existing landfills, means for restoring areas damaged by such earlier or existing landfills, means for rendering landfills safe for purposes of construction and other uses, and techniques of recovering materials and energy from landfills.

SPECIAL STUDIES; PLANS FOR RESEARCH, DEVELOPMENT, AND DEMONSTRATIONS:

"Sec. 8002.(g) SLUDGE.--The Administrator shall undertake a comprehensive study and publish a report on sludge. Such study shall include an analysis of--

"(1) what types of solid waste (including but not limited to sewage and pollution treatment residues and other residues from industrial operations such as extraction of oil from shale liquefaction and gasification of coal and coal slurry pipeline operations) shall be classified as sludge;

"(2) the effects of air and water pollution legislation on the creation of large volumes of sludge;

"(3) the amounts of sludge originating in each State and in each industry producing sludge.

"(4) methods of disposal of such sludge, including the cost, efficiency, and effectiveness of such methods;

"(5) alternative methods for the use of sludge, including agricultural applications of sludge and energy recovery from sludge."

Appendix G

Addresses for State Guidelines on Land Treatment

Guidelines for land application of wastes vary from one state to another. For the most up-to-date information about guidelines and regulations on land treatment of wastes in each particular state, the following agencies should be contacted. It may be useful to compare your state's guidelines with those of another. Examining other states' guidelines may be especially helpful if your state has no specific guidelines.

This list of names and addresses is current as of September, 1977. (States and the appropriate agency will be listed in alphabetical order)

Appendix G

Addresses for State Guidelines on Land Treatment

Alabama James W. Warr
Chief Administrative Officer
Water Improvement Commission
State of Alabama
Perry Hill Office Park
3815 Interstate Court
Montgomery, AL 36109

Alaska Johnathan W. Scribner, Dir.
Water Programs, Department
of Environmental Conservation
Pouch O
Juneau, AK 99811

Arizona Wm. H. Shafer, Assistant Chief
Technical Services & Support
Dept. of Health Services
Bureau of Water Quality Control
1740 West Adams
Phoenix, AZ 85007

Arkansas Vel Deguzman, P. F.
Arkansas Dept. Pollution Control
& Ecology
P.O. Box 9853
Little Rock, AR 72219

California W. R. Attwater, Chief Coun.
State Water Resources
Control Board
P.O. Box 100
Sacramento, CA 95801

Colorado Felix L. Sparks, Director
Water Conservation Board
102 Columbine Bldg.
1845 Sherman Street
Denver, CO 80203

Connecticut Robert B. Taylor
Director of Water Compliance
& Hazardous Substances
State Office Building
Hartford, CT 06115

Delaware Robert J. Zimmerman
Resource Engineer
Water Resources Section
Division of Environmental Control
Tatnall Building
Dover, DE 19901

Florida
G. J. Thabaraj, Ph.D.
Dept. of Environ. Regulation
2562 Executive Center Circle, East
Tallahassee, FL 32301

Georgia
Mr. Harold Reheis
Section Chief
Water Quality Control Section
Environmental Protection Div.
Ga. Dept. of Natural Resources
Trinity-Washington Bldg.
Atlanta, GA 3031

Hawaii
George Yuen
Director of Health
Department of Health
P.O. Box 3378
Honolulu, HI 96801

Idaho
Darrel Clapp, Supervisor
Environmental Studies
Department of Water Resources
State House
Boise, ID 83720

Illinois
Darryll Bauer, P. E.
Chairman, Committee on Sludge
Illinois Envir. Protection Agen.
2200 Churchill Road
Springfield, IL 62706

Indiana
Steve W. Kim, Chief
Division of Water Pollution Con.
State Board of Health
1330 West Michigan Street
Indianapolis, IN 46206

Iowa
Larry E. Crane
Executive Director
3920 Delaware Avenue
P. O. Box 3326
Des Moines, IA 50316

Kansas
H. A. Janzen, Chief
W. P. C. Section
Kansas Dept. of Health &
Environment
Topeka, KA 66620

Kentucky
William S. Forester, Director
Dept. for Natural Resources &
Environmental Protection
Bureau of Env. Protection
Frankfort, KY 40601

Louisiana	James F. Coerver, Head Bureau of Environmental Services Louisiana Health & Human Res. Administration Division of Health P.O. Box 60630 New Orleans, LA 70160
Maine	Frank W. Ricker Executive Director Soil & Water Conser. Commis. State Office Building Augusta, ME 04330
Maryland	Peter S. Tinsley, Hydrologist Groundwater Permits Section Department of Natural Resources Tawes State Office Bldg. Annapolis, MD 21401
Massachusetts	John R. Elwood, Supv. San. Engr. Mass. Division of Water Poll. Control P.O. Box 545 Westboro, MA 01581
Michigan	Paul A. Blakeslee Water Quality Division Mich. Dept. of Natural Res. P. O. Box 30028 Lansing, MI 48909
Minnesota	Dale L. Wikre, Geologist Division of Water Quality Minnesota Poll. Control Agency 1935 West County Road B2 Roseville, MN 55113
Mississippi	Charles Chisolm P.O. Box 827 Jackson, MS 39205
Missouri	University of Missouri Publications B-9 Whitten Hall Columbia, MO 65201
Montana	D. G. Willen, Chief Water Quality Bureau State Dept. of Health & Env. Science Helena, MT 59601

Nebraska
Nate Beezley, P. E.
Water Pollution Control Div.
Nebraska Dept. of Environ.
Con. Control
Box 94653 State House Station
Office 301 Centennial Mall
South
Lincoln, NB 68509

Nevada
James B. Williams, Jr. P. E.
Department of Human Resources
Environmental Protection Ser.
Capitol Complex
Carson City, NV 89710

New Hampshire
Russell S. Bowie, Assoc. San. Eng.
N. H. WS. & P. C. C.
P.O. Box 95 105 Loudon Rd.
Concord, NH 03301

New Jersey
Haig F. Kasabach
Division of Water Resources
Dept. of Envir. Protection
P. O. Box 2809
Trenton, NJ 08625

New Mexico
Maxine S. Goad
New Mexico Environmental
Improvement Agency
P.O. Box 2348
Santa Fe, NM 87503

New York
Frank O. Bogedain, P.E.
Division of Pure Waters
NY Department of Envir. Con.
50 Wolf Road
Albany, NY 12233

North Carolina
M. W. Puette, Enforcement Administrator
Division of Envir. Manage.
Dept. of Natural Resources
P. O. Box 27687
Raleigh, NC 27611

North Dakota
Norman L. Peterson, Director
Div. of Water Sup. & Poll. Con.
State Capitol Bldg.
Bismarck, ND 58505

Ohio
Division of Hazardous Waste
Control
Ohio EPA
Box 1049
361 E. Broad St.
Columbus, OH 43216

Oklahoma	Mark S. Coleman, Director Water Quality Man. & Research Oklahoma State Dept. of Health P.O. Box 53551 Oklahoma City, OK 73105
Oregon	Diarmuid F. O'Scannlain, Dir. Dept. of Environmental Quality 1234 S.W. Morrison Portland, OR 97205
Pennsylvania	William D. LaCour Planning Analyst Div. of Solid Waste Management P.O. Box 2063 Harrisburg, PA 17120
Rhode Island	J. S. Quinn, Jr. Room 204 Health Dept. Providence, RI 02908
South Carolina	Roger E. Davis, P.E. Bureau of Wastewater & Stream Quality Control J. Marion Sims Bldg. 2600 Bull St. Columbia, SC 29201
South Dakota	Tom Becker Public Info. Specialist Dept. of Environmental Protection Pierre, SD 57501
Tennessee	Water Quality Control Board Dpet. of Public Health 621 Cordell Hull Bldg. Nashville, TN 37219
Texas	Henry L. Dabney, P.E., Director Div. of Wastewater Tech. & Surveillance Texas Dept. of Health Resources Austin, TX 78756
Utah	Don A. Ostler 44 Medical Drive Salt Lake City, UT 84113
Vermont	William J. Siok, Hydrogeologist Env. Eng. Div. Vermont Agency of Envir. Conservation State Office Bldg. Montpelier, VT 05602

Virginia	William L. Magette, Engineer State Water Control Board 2111 North Hamilton Street P. O. Box 11143 Richmond, VA 23230
Washington	LaVerne DeNike State of Washington Department of Ecology Solid Waste/Resource Recov. Div. Olympia, WA 98504
West Virginia	William W. Bradford, P.E. Asst. Chief, Sewage Program Division of Sanitary Engineering Department of Health Charleston, WV 25305
Wisconsin	Robert W. Schaefer Box 7921 Madison, WI 53711
Wyoming	William L. Garland, Administrator Dept. Environmental Quality Water Quality Division Basement, Hathaway Building Cheyenne, WY 82002

Appendix H

Addendum No. 2

To Recommended Standards for Sewage Works

Great Lakes-Upper Mississippi River Board of State Sanitary Engineers (GLUMRB)
(1968 Edition)

April 1971

Ground Disposal of Wastewaters

Interest has been expressed in the development of guidelines for engineering review of proposed projects for ground disposal of wastewaters.

There are apparently relatively few known large-scale installations of spray irrigation systems and very limited data available within the ten GLUMRB states.

The protection of groundwater and surface resources is the major concern in the development of guidelines. However, quality of groundwater discharged to surface waters also must be considered the water quality criteria.

Practices must be established which will help prevent wastes of any nature from being introduced into the fresh groundwaters which will so change their characteristics as to make them unsuitable for potable water supply or other present and future usage.

The priority of the water usage is subject to the jurisdiction of the appropriate state and local regulatory agencies.

Preliminary Considerations

Ground disposal installations are normally used where the waste contains pollutants which can successfully be removed through distribution to the soil mantle. These pollutants can be removed through organic decomposition in the vegetation-soil complex and by adsorptive, physical, and chemical reactions with earth materials. Preliminary considerations of a site for ground disposal should be the compatibility of the waste with the organic and earth materials and the percolation rates and exchange capacity of the soils. The ground disposal of wastewater will eventually recharge the local groundwater; therefore, the quality, direction and rate of movement and local use of the groundwater, present and potential, are prime considerations in evaluating a proposed site.

It is essential to maintain an aerated zone of at least five feet and preferably more, to provide good vegetation growth conditions and removal of nutrients. It must be realized a groundwater mount will develop below after it is in use. The major factors in design of ground disposal fields are topography, soils, geology, hydrology, weather, agricultural practice, adjacent land use and equipment selection and installation.

Design Report

The design report shall include maps and diagrams as noted below. It shall also include any additional material that is pertinent about the location, geology, topography, hydrology, soils, areas for future expansion and adjacent land use.

Location

(1) A copy of the U.S.G.S. topographic map of the area (7 1/2-minute series where published) showing the exact boundaries of the spray field.

(2) A topographic map of the total area owned by the applicant at a scale of approximately one inch to 50 feet. It should show all buildings, the waste disposal system, the spray field boundaries and buffer zone. An additional map should show the spray field topography in detail with a contour interval of two feet, and include buildings and land use on adjacent lands within 1/4 mile of the project boundary.

(3) All water supply wells which might be affected shall be located and identified as to uses; e.g., potable, industrial, agricultural, and class of ownership; e.g., public, private, etc.

(4) All abandoned wells, shafts, etc., shall be located and identified. Pertinent information thereon shall be furnished.

Geology

(1) The geologic formations (name) and the rock types at the site.

(2) The degree of weathering of the bedrock.

(3) The local bedrock structure including the presence of faults, fractures and joints.

(4) The character and thickness of the surficial deposits (residual soils and glacial deposit).

(5) In limestone terrain, additional information about solution openings and sinkholes is required.

(6) The source of the above information must be indicated.

Hydrology

(1) The depth to seasonal high water table (perched and/or regional) must be given, including an indication of seasonal variations. Static water levels must be determined at each depth for each aquifer in the depth under concern. Critical slope evaluation must be given to any differences in such levels.

(2) The direction of groundwater movement and the point(s) of discharge must be shown on one of the attached maps.

(3) Chemical analyses indicating the quality of groundwater at the site must be included.

(4) Indicate the source of the above data.

(5) The following information shall be provided from existing wells and from such test wells as may be necessary:

(a) Construction details - where available: Depth, well log, pump capacity, static levels, pumping water levels, casing, grout material and such other information as may be pertinent.

(b) Groundwater quality: E.g., Nitrates, total nitrogen, chlorides, sulphates, pH, alkalinities, total hardness, coliform bacteria, etc.

(6) A minimum of one (1) groundwater monitoring well must be drilled in each dominant direction of groundwater movement and between the project site and public well(s) and/or high capacity private wells with provision for sampling at the surface of the water table and at five (5) feet below the water table at each monitoring site. The location and construction of the monitoring well(s) must be approved. These may include one or more of the test wells where appropriate.

Soils

(1) A soils map should be furnished of the spray field, indicating the various soil types. This may be included on the large-scale topographic map. Soils information can normally be secured through the USDA Soil Conservation Service.

(2) The soils should be named and their texture described.

(3) Slopes and agricultural practice on the spray field are closely related. Slopes on cultivated fields should be limited to 4% or less. Slopes on sodded fields should be limited to 8% or less. Forested slopes should be limited to 8% for year-round operation, but some seasonal operation slopes up to 14% may be acceptable.

(4) The thickness of soils should be indicated. Indicate how determined.

(5) Data should be furnished on the exchange capacity of the soils. In case of industrial wastes particularly, this information must be related to special characteristics of the wastes.

(6) Information must be furnished on the internal and surface drainage characteristics of the soil materials.

(7) Proposed application rates should take into consideration the drainage and permeability of the soils, the discharge capacity, and the distance to the water table.

Agricultural Practice

(1) The present and intended soil-crop management practices, including forestation, shall be stated.

(2) Pertinent information shall be furnished on existing drainage systems.

(3) When cultivated crops are anticipated, the kinds used and the harvesting frequency should be given; the ultimate use of the crop should also be given.

Adjacent Land Use

(1) Present and anticipated use of the adjoining lands must be indicated. This information can be provided on one of the maps and may be supplemented with notes.

(2) The plan shall show existing and proposed screens, barriers, or buffer zones to prevent blowing spray from entering adjacent land areas.

(3) If expansion of the facility is anticipated, the lands which are likely to be used for expanded spray fields must be shown on the map.

Treatment Before Land Disposal

In general, the equivalent of secondary treatment will be required. All wastes must be amenable to treatment by the soil prior to application. All wastes to be spray irrigated shall be disinfected. Disinfection may be required for other types of irrigation. Screening shall be provided in all cases where solids are expected of a size equal to or greater than the nozzle hole diameter.

Storage shall be provided to the maximum capacity required to accommodate flows in excess of quantities to be irrigated.

Piping to Sprinklers

The piping should be so arranged to allow the irrigation pattern to be varied easily. Stationary systems are preferred; but if a moveable system is proposed, one main header must be provided with individual connections for each field and sufficient spare equipment must be available to assure non-interrupted irrigation. Facilities must be provided to allow the pipes to be completely drained at suitable points to prevent pollution and freezing.

Sprinkling System

Sprinklers must be so located as to give a non-irrigated buffer zone around the irrigated area and design of the buffer zone must consider wind transport of the wastewaters. The system shall be designed to provide an even distribution over the entire field.

The application rate must be selected low enough to allow the waters to percolate into the soil and to assure proper residency within the soil mantle. Proposed application rates will not be accepted without substantiating data.

In general, sufficient monitoring controls should be provided to indicate the degree of efficiency with which the sprinklers are working. A pressure gauge and flow meter should be provided.

Runoff

The system shall be designed to prevent surface runoff from entering or leaving the project site.

Fencing

The project area shall be enclosed with a suitable fence to preclude livestock and discourage trespassing. A vehicle access gate of sufficient width to accommodate mowing equipment should be provided. All access gates should be provided with locks.

Warning Signs

Appropriate signs should be provided along the fence around the project boundaries to designate the nature of the facility and advise against trespassing.

Bibliography: Agricultural Utilization of Sewage Effluent and Sludge, an Annotated Bibliography, Federal Water Pollution Control Administration, U.S. Department of the Interior, January, 1968.

Appendix J

Text of memo from Douglas Costle

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

SUBJECT: Land Treatment DATE: October 3, 1977

FROM: The administrator /s/ Douglas Costle

TO: Assistant Administrators and
Regional Administrators (Regions I-X)

President Carter's recent Environmental Message to the Congress emphasized the design and construction of cost-effective publicly owned wastewater treatment facilities that encourage water conservation as well as adequately treat wastewater. This serves to strengthen the encouragement under the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) to consider wastewater reclamation and recycling by land treatment processes.

At the time P.L. 92-500 was enacted, it was the intent of Congress to encourage to the extent possible the development of wastewater management policies that are consistent with the fundamental ecological principle that all materials should be returned to the cycles from which they were generated. Particular attention should be given to wastewater treatment processes which renovate and reuse wastewater as well as recycle the organic matter and nutrients in a beneficial manner. Therefore, the Agency will press vigorously for publicly owned treatment works to utilize land treatment processes to reclaim and recycle municipal wastewater.

RATIONALE

Land treatment systems involve the use of plants and the soil to remove previously unwanted contaminants from wastewaters. Land treatment is capable of achieving removal levels comparable to the best available advanced wastewater treatment technologies while achieving additional benefits. The recovery and beneficial reuse of wastewater and its nutrient resources through crop production, as well as wastewater treatment and reclamation, allow land treatment systems to accomplish far more than most conventional treatment and discharge alternatives.

The application of wastewater on land is a practice that has been used for many decades; however, recycling and reclaiming wastewater that may involve the planned recovery of nutrient resources as part of a designed wastewater treatment facility is a relatively new technique. One of the first such projects was the large scale Muskegon, Michigan, land treatment demonstration project funded under the Federal Water Pollution Control Act Amendments of 1966 (P.L. 84-660), which began operations in May 1974.

Reliable wastewater treatment processes that utilize land treatment concepts to recycle resources through agriculture, silviculture and aquaculture practices are available. The technology for planning, designing, constructing and operating land treatment facilities is adequate to meet both 1983 and 1985 requirements and goals of P.L. 92-500.

Land treatment is also presently in extensive use for treatment of many industrial wastewaters, particularly those with easily degraded organics such as food processing. Adoption of suitable in-plant pretreatment for the removal of excessive metals and toxic substances would expand the potential for land treatment of industrial wastewater and further enhance the potential for utilization of municipal wastewater and sludges for agricultural purposes.

APPROACH

Because land treatment processes contribute to the reclamation and recycling requirements of P.L. 92-500, they should be preferentially considered as an alternative wastewater management technology. Such consideration is particularly critical for smaller communities. While it is recognized that acceptance is not universal, the utilization of land treatment systems has the potential for saving billions of dollars. This will benefit not only the nationwide water pollution control program, but will also provide an additional mechanism for the recovery and recycling of wastewater as a resource.

EPA currently requires each applicant for construction grant funds to make a conscientious analysis of wastewater management alternatives with the burden upon the applicant to examine all available alternative technologies. Therefore, if a method that encourages water conservation, wastewater reclamation and reuse is not recommended, the applicant should be required to provide complete justification for the rejection of land treatment.

Imposition of stringent wastewater treatment requirements prior to land application has quite often nullified the cost-effectiveness of land treatment processes in the past. We must ensure that appropriate Federal, State and local requirements and regulations are imposed at the proper point in the treatment system and are not used in a manner that may arbitrarily block land treatment projects. Whenever States insist upon placing unnecessarily stringent preapplication treatment requirements upon land treatment, such as requiring EPA secondary effluent quality in all cases prior to application on the land, the unnecessary wastewater treatment facilities will not be funded by EPA. This should encourage the States to re-examine and revise their criteria, and so reduce the cost burden, especially to small communities, for construction and operation of unnecessary or too costly facilities. The reducation of potentially toxic metals and organics in industrial discharges to municipal systems often is critical to the success of land treatment. The development and enforcement at the local level of pretreatment standards that are consistent with national pretreatment standards should be required as an integral part of any consideration or final selection of land treatment alternatives. In addition, land treatment alternatives must be fully coordinated with on-going areawide planning under section 208 of the Act. Section 208 agencies should be involved in the review and development of land treatment options.

Research will be continued to further improve criteria for preapplication treatment and other aspects of land treatment processes. This will add to our knowledge and reduce uncertainties about health and environmental factors. I am confident, however, that land treatment of municipal wastewaters can be accomplished without adverse effects on human health if proper consideration is given to design and management of the system.

INTER-OFFICE COORDINATION

The implementation of more recent mandates from the Safe Drinking Water Act (P.L. 93-532), the Toxic Substances Control Act (P.L. 94-469), and the Resource Conservation and Recovery Act of 1976 (P.L. 94-580) must be closely coordinated with the earlier mandate to recycle wastes and fully evaluate land treatment in P.L. 92-500. Agencywide coordination is especially important to the proper management of section 201 of P.L. 92-500, because the construction and operation of thousands of POTW's involve such a broad spectrum of environmental issues. A concerted effort must be made to avoid unilateral actions, or even the appearance of unilateral actions, which satisfy a particular mandate of one Act while inadvertently conflicting with a major Agency policy based upon another Act. The intention of P.L. 92-500, as it concerns land treatment, is compatible with the pertinent aspects of more recent environmental legislation.

ACTION REQUIRED

Each of you must exert maximum effort to ensure that the actions of your staffs reflect clearly visible encouragement of wastewater reclamation and recycling of pollutants through land treatment processes in order to move toward the national goals of conserving water and eliminating the discharge of pollutants in navigable waters by 1985.

This policy will apply to all future municipal construction grant activities, as well as all current grant applications in the Step 1 category that have not been approved as of this date. Detailed information and guidance for implementation of this policy is under preparation and will be issued in the near future.

ACKNOWLEDGEMENTS

The development of this program and the preparation of the modules resulted from the collaboration of many individuals in the College of Agriculture and Life Sciences, a statutory unit of the State University at Cornell University, and others. The primary faculty and staff associated with the project were:

PROFESSIONAL STAFF

W. W. Clarkson, Research Associate	Agricultural Engineering
G. S. Friedman, Research Associate	Education
A. C. Plescia, Production Coordinator	Agricultural Engineering

PRINCIPAL FACULTY PARTICIPANTS

W. J. Jewell, Agricultural Engineering	Principal Faculty Advisor
R. C. Loehr, Environmental Studies Program	Project Coordinator
J. D. Novak, Education	Principal Faculty Advisor
E. L. Stone, Agronomy	Principal Faculty Advisor

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The current modules are based on modules developed during the initial phase of this project (1974-1976). Other personnel involved with writing or editing initial modules of the program included:

G. A. Garrigan, Education
S. D. Klausner, Agronomy
C. E. Morris, Education
D. F. Smith, Agricultural Engineering
J. E. Stone, Agronomy

M. M. Bogin edited copy and contributed to written and audio-tutorial modules. S. M. Dabney was the primary author of the Crop Selection and Non-crop and Forest Systems modules.

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